

SECTION 01 10 00-SUMMARY OF WORK

PART 1 – GENERAL

1.1 SUMMARY

- A. The work to be performed under this Contract is shown on the Drawings and defined in the Specifications. This section covers certain specific information to further clarify the intent and requirements of the Contract.
- B. The DESCRIPTION or SUMMARY paragraphs in each section are statements or short word summaries of the content of the section. These paragraphs are not intended to “scope” the section. They merely give a brief description of the significant items described in the section and are used to simplify the finding of specific information.
- C. The “related work” paragraphs are also not meant to be all-inclusive. They serve the function of assisting the reader in locating specific information.
- D. PRIOR to the “Notice to Proceed,” specific submittals must be approved by the Government. See related section 01300 – Submittals.

1.2 DEFINITIONS

Owners: Federal Aviation Administration; and
The Bermuda Department of Tourism and Transportation; through
The Bermuda Department of Airport Operations (DAO)

1.3 QUALITY ASSURANCE

- A. The Contract Documents are listed in the Invitation for Bid – Instructions to Bidders.
- B. The contractor shall provide all labor, materials (with the exception of Government Furnished Materials) and equipment required to perform the work shown in the contract documents and described herein. All work performed and all materials and equipment shall be subject to Government approval. This shall include but not be limited to testing, inspection, scheduling, reporting, and submittals.
- C. The demolition and reconstruction of this facility shall be in accordance with the drawings. The contractor shall not use dimensions scaled from the drawings. Field verify all dimensions.
- D. Any differences or discrepancies among the contract documents shall be referred to the Government for a written determination. In the event of difference among the contract documents, the order of precedence to determine which provision shall govern is as follows:
 - 1. Written Agreement (Change Order to the Contract)
 - 2. Project Specifications
 - 3. Project Drawings

SECTION 01 10 00 – SUMMARY OF WORK

1.4 PROJECT DESCRIPTION

Work at the VOR Site:

- A. Contractor will remove and replace supporting steel frame and associated reinforced concrete foundations for the VOR counterpoise.
- B. The work to be performed under this contract includes all work shown on the drawings and specifications, to include, but not limited to the following:
 - 1. Demolish and remove the steel structure supporting the counterpoise & various antennas.
 - 2. Remove all communication and power cables, de-terminated by others.
 - 3. Retain the counterpoise material for possible future use
 - 4. Retain the sixteen monitor detector antennas (MDA's) and brackets for future use.
 - 5. Retain the antenna shelter, all junction boxes, RF boxes, the obstruction light, and MDA boxes for future use.
 - 6. Demolish and remove ten (10) reinforced concrete foundation elements.
 - 7. Perform earthwork necessary to replace ten (10) reinforced concrete foundations.
 - 8. Construct ten (10) reinforced concrete foundations for the counterpoise support structure.
 - 9. Install the counterpoise structure complete with monitor detector antennas and DME antenna shelter.
 - 10. Install power and communication cable between the end use device and the point of disconnect or ground identified during demolition.
 - 11. Install the facility grounding system and restore areas disturbed during demolition.
 - 12. Construct or install all items removed in the demolition phase and appurtenances as described herein or indicated by the drawings unless indicated otherwise.
 - 13. Obtain a successful test of all reinstalled power and communication cables.
 - 14. Electronic equipment within the equipment building will not be removed or relocated.

1.5 CONSTRUCTION SCHEDULE

Milestones:

- A. The following are the major milestone dates that the Contractor is required to meet. These dates shall be reflected in the construction schedule required to be submitted by other sections of these specifications.

Work Item:	Date:
1. Pre-Bid Meeting on Site	TBD
2. Contract Award	TBD
3. "Key" Submittals (see 01 33 00 1.1A)	TBD
4. Notice to Proceed	TBD
5. Pre-Construction Meeting On Site	TBD
6. VOR Counterpoise Frame Demolition	TBD
7. Foundations Demolition	TBD

8.	Foundations Constructed	TBD
9.	Counterpoise Frame Steel Replaced	TBD
10.	Counterpoise plate and peripherals replaced	TBD
11.	Contractor Acceptance Inspection Conducted	TBD
12.	Punch-list Complete	TBD
13.	Contract Closeout	TBD

- B. Weather: Make appropriate allowances for both normal and potentially adverse weather conditions, which may reasonably be expected in Bermuda during the construction period. No schedule extensions will be granted due to adverse weather. No additional compensation will be paid for the means and measures required to maintain the construction schedule under adverse weather conditions.
- C. Government Furnished Equipment. (GFE): No GFE is planned; however, several existing items supported by the counterpoise frame structure will be re-installed after the new counterpoise frame is in place. These items include but are not limited to the obstruction light on the teepee, the teepee, the RF box, the MDA boxes, and other junction boxes, the monitor detector antennas with brackets, the DME antenna, the VOR antenna, conduit, and air conditioning duct.
- D. The contractor is expected to have all work complete and the system ready for return to service (by others) TBD calendar days after the contract award and notice to proceed. This includes electrical and HVAC portions of the project impacted by contractor activities. The contractor site superintendent shall be on site when any work is performed. The DME and Alfred Loop VOR Antennas will be installed by others. The RF bridge and transmission line ¼ ", heliax cables will be replaced by the owner.
- E. The contractor shall maintain all items detailed in Specification section 01500.

END OF SECTION 01 10 00

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SECTION 01 10 15 – ACRONYMS AND DEFINITIONS

ANSI - American National Standards Institute
ARI - Air Conditioning & Refrigeration Institute
ASHRAE-American Society of Heating, Refrigeration, & Air Conditioning Engineers
ASME - American Society of Mechanical Engineers
ASTM - American Society for Testing & Materials
ATCT - Air Traffic Control Tower
CSI - Construction Specifications Institute
COR – Contracting Officer’s Representative
COTR- Contracting Officer’s Technical Representative
CAI – Contractor Acceptance Inspection
E/G - Engine/Generator
FM - Factory Mutual
GFE/M - Government Furnished Equipment/Material
HVAC - Heating, Ventilation, & Air Conditioning
IFB - Invitation For Bid
NEMA - National Electrical Manufacturers Association
NFPA - National Fire Protection Association
NOAA - National Oceanic and Atmospheric Administration
OSHA - Occupational Safety & Health Administration
RE - Government’s Resident Engineer
SRI - Site Readiness Inspection
UL - Underwriter Laboratories
UPS - Uninterruptible Power Source
W/G - Waveguide
XMTR – Transmitter

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SECTION 01 14 00 - SPECIAL PROVISIONS

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section Consists of Special Provisions Required for this Project.
- B. Related Work Covered Elsewhere:
 - a. Section 01 33 00 - Submittals
 - b. Section 01561 - Environmental Protection
 - c. Section 01700 – Contract Closeout

1.2 JOB CONDITIONS:

- A. Written notification of any planned shut-down of existing facilities and/or utilities which may affect airport operations, shall be provided to the Government RE two weeks in advance of such a shutdown. Shutdown shall not proceed without RE's written approval.
- B. Coordinate with Power Company to provide permanent or temporary power to site if required. On-site power will not be available to the contractor.

1.3 PLAN OF ACTION:

- A. Do not perform any work which will require shutting down essential services, including electrical power, communications power, or facility functions without an RE approved Plan of Action.
- B. Submit a typewritten Plan of Action to the RE describing the construction necessary, the utilities, piping or other services that will be affected, the length of time that each service or utility will be disturbed, and the procedures to be used by the Contractor to carry out the work in a timely manner. Include action to be taken in case of emergencies, and an alternate plan that can be employed in the event that the original schedule cannot otherwise be met. The RE must have approved the plan prior to any work being performed.
- C. All planned shutdowns must have prior RE approval in all circumstances, and shall be scheduled in a manner to create the minimum amount of interference with the existing airport operations. When shutdowns are necessary and approved by the RE, employ additional labor and work overtime as necessary to restore the facilities to operation at the earliest possible time.

1.4 HAZARDOUS MATERIAL CERTIFICATION

- A. Asbestos containing materials (ACM) shall not be permitted for use on this Project. Provide letters of certification for the project at completion, certifying no asbestos containing material was used.
- B. Lead-free materials: Provide letters of certification for the project at completion, certifying only lead-free paints (i.e. less than 0.5% lead content) and flashing were used.

- C. Hazardous materials or residues: In the event that the Contractor encounters hazardous material, including asbestos, anywhere on the job-site, he shall immediately stop work in that area and report to the RE. Also, the contractor shall comply with all OSHA, U. S. Federal, and local requirements as to the handling of the material.

1.5 PERMANENT ELECTRIC POWER AND TELEPHONE SERVICE

- A. The availability of or access to permanent power or telephone service for the contractor's use is not guaranteed. Contractor shall furnish all utilities.
- B. Coordinate with the Utility Companies and the airport authority through the RE regarding power and water or sewer services desired prior to starting construction, contact information to be provided by the resident engineer (RE.)
- C. Contractor shall pay all fees and charges required to establish, maintain, and remove temporary electric, telephone, and other services to the facility until Government acceptance of Contract Closeout. Refer to Section 01700 for detail of Contract Closeout.
- D. When temporary services are no longer needed, contractor shall remove all connections and return the site to its condition prior to establishing the temporary services.
- C. Furnishing permanent power, telephone service, or other permanent utilities is not included in this project or contract.

PART 2 – PRODUCTS

2.1 MATERIALS

Materials shall be as specified in the various sections of these specifications.

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SECTION 01 20 00 - APPLICABLE STANDARDS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Work Included

1. Throughout the Contract Documents, reference is made to codes and standards which establish qualities and types of workmanship and materials, and which establish methods for testing and reporting on the pertinent characteristics.
2. Where materials or workmanship are required by these Contract Documents to meet or exceed the specifically named code or standard, it is the Contractor's responsibility to provide materials and workmanship, which meet or exceed the specifically named code or standard.
3. It is also the Contractor's responsibility, when so required by the Contract Documents or by written request from the Government, to deliver to the Government all required proof that the materials or workmanship, or both, meet or exceed the requirements of the specifically named code or standard. Such proof shall be in the form requested in writing by the Government, and generally will be required to be copies of a certified report of tests conducted by a testing agency approved for the purpose by the Government.

B. Related Work:

Specific naming of codes or standards occurs on the Drawings and in the other Sections of these Specifications.

1.2 QUALITY ASSURANCE

A. Familiarity with Pertinent Codes and Standards

In procuring all items used in this work, it is the Contractor's responsibility to verify the detailed requirements of the specifically named codes and standards and to verify that the items procured for use in this work meet or exceed the specified requirements.

B. Rejection of Non-Complying Items

The Government reserves the right to reject items incorporated into the work which fail to meet the specified minimum requirements. The Government further reserves the right, and without prejudice to other recourse the Government may take, to accept non-complying items subject to an adjustment in the Contract Amount as approved by the Government and the FAA.

- ##### C.
- Applicable standards listed in the Specifications or Drawings include, but are not necessarily limited to, standards promulgated by the following agencies and organizations:

AASHTO American Association of State Highway Transportation Officials
ACI American Concrete Institute
AISC American Institute of Steel Construction
AMCA Air Moving and Conditioning Association, Inc.
ANSI American National Standards Institute
APA American Plywood Association
ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASTM American Society of Testing and Materials
AWPA American Wood Preservers' Association
BOCA Building Officials' Code Association
CRSI Concrete Reinforcing Steel Institute
CS Commercial Standards (US Dept. of Commerce)
DOE US Department of Environment
EPA US Environmental Protection Agency
FAA Federal Aviation Administration
FCC Federal Communications Commission
FS Federal Specifications
MNBHA National Builders Hardware Association
NCMA National Concrete Masonry Association
NEC National Electric Code
NEMA National Electrical Manufacturers Association
NFPA National Fire Protection Association
OSHA Occupational Safety & Health Administration
SMACNA Sheet Metal and Air Conditioning Contractors National Association, Inc.
TPI Truss Plate Institute
UL Underwriters' Laboratory, Inc.

D. Federal Specifications

The Federal specifications and standards and supplements, amendments, and indices thereto are prepared and issued by the General Services Administration of the Federal Government of the United States. They may be obtained from the Specifications Activity, Printed Materials Supply Division, Building 197, Washington Navy Yard, Washington, D.C. 20407.

E. Publications

1. Copies of military documents may be obtained from the Commanding Officer, Naval Supply Depot, 6801 Tabor Avenue, Philadelphia, Pennsylvania 19120, Attention: Code CDS.

2. Information on obtaining copies of Federal specifications and standards may also be obtained from General Services Administration offices in Atlanta; Boston; Chicago; Denver; Fort Worth; Houston; Kansas City, MO; Los Angeles; New York; Philadelphia; San Francisco; Seattle; and Washington, D.C.

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SECTION 01 30 00 – ADMINISTRATIVE REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY:

A. Perform administrative functions as necessary to ascertain that the work conforms to the Construction Documents.

B. Related Work Covered Elsewhere:

1. Summary of Work: Section 01010
2. Special Provisions: Section 01030
3. Job Management: Section 01041
4. Submittals: Section 01 33 00
5. Contract Closeout: Section 01700
6. Cleaning: Section 01710
7. Project Records Documents: Section 01730

1.2 LOCAL PERMITS

Local permits or coordination may be required. Agencies with jurisdiction include but are not limited to:

1. Bermuda Land Development Company, PO Box DD 221, St. David's, Bermuda, DD BX
2. Bermuda Department of Planning, Dame Lois Brown-Evans Building, 5th Floor, 58 Court St., Hamilton, HM 12, Bermuda
3. Bermuda Telephone Company, Ltd., 30 Victoria St., City of Hamilton, Bermuda, HM 12
4. Bermuda Transport Control Department, 11 North St., PO box HM 718 Hamilton HM CX, City of Hamilton, Bermuda, HM 17
5. Bermuda Registrar of Companies
6. H.M. Customs Bermuda
7. National Training Board, Brown Brangman Bldg., 2nd Floor, 100 Reid St., City of Hamilton, Bermuda, HM 11
8. Fire & Rescue Services, Clearwater/Airport Operations Division Fire Station (Eastern Area) Bldg. 0637, Wallars Point Rd., St. David's, Bermuda, DD 01
9. Bermuda Hospital Board, 7 Point Finger Rd., Paget, Bermuda, DV 04
10. Bermuda Electric Company (BELCO), 27 Serpentine Rd. Pembroke, Bermuda, HM 07

1.3 JOB CONDITIONS

A. Division Of Work:

1. The drawings are not divided into areas of responsibility for the various trades. It is the Contractor's sole responsibility to divide the work among his trades and sub-contractors. The contractor is fully responsible for the coordination of all trades and subcontractors on the project.
2. The division of specifications into areas of similar types of work is not intended to represent a division of work between trades or sub-contractors, but merely for convenience in reading specifications or drawings. Separation of specifications into sections or representation of like work on the drawings is not intended to define the limits of responsibility for completion of the work. The Government shall not act as an arbiter to establish subcontract limits or among contractors, sub-contractors, among trades, or between different trades and subcontractors.

B. Qualifications:

1. The Contractor for this project shall demonstrate his experience and ability to perform the work satisfactorily. Experience must include substantial recent, experience in importing manpower, material, and equipment into Bermuda. The contractor must also demonstrate knowledge of the rules for exporting items from the United States to Bermuda. The contractor shall have adequate manpower for the task assigned and must be financially capable of producing the assigned tasks on schedule.
2. Section 02200-Earthwork: Contractor shall be skilled in the site work for buildings, and shall demonstrate his knowledge and experience in this line of work by providing references. The contractor shall have a minimum of five (5) years' experience in foundation work, steel erection, and electrical installation work of similar nature. Experience must include experience with the anticipated subsurface materials, drainage techniques, and environmental protection activities necessary on this project.

1.4 GUARANTEES

Warrant materials and equipment furnished by the various manufacturers in writing, for period of one (1) year, or not less than the industry standard for the material specified, nor the manufacturer's standard warranty period, whichever is greater.

1.5 DRAWINGS AND SPECIFICATIONS:

- A. Government will issue three (3) sets of drawings and specifications to the Contractor. The Contractor shall print any additional copies, as he deems necessary for the execution of the work, at no additional cost to the Government.
- B. Electrical drawings and drawings relating to ductwork and piping are schematic; dimensions shall be field verified. Dimensions on the government furnished drawings are schematic and shall be followed without regard to scale. Drawings show the general arrangement and the extent of the work. Exact location and equipment arrangement shall be determined by the physical dimensions of the equipment or material currently in place. Contractor's shop drawings shall show contractor verified dimensions of the existing structure,

cable, conduit, junction boxes, Monitor Detector Antennas and associated junction boxes, and all devices and elements associated with the counterpoise steel frame.

1.6 PROJECT MEETINGS:

The Contractor shall conduct weekly coordination meetings with the RE to discuss conditions that affect the execution of the work. Contractor shall provide the location for the meetings and take minutes of these meetings and distribute copies to concerned individuals. Contractor shall provide at each meeting a rolling two (2) week schedule of expected construction activities.

PART 2 - PRODUCTS - (Not Used)

PART 3 – EXECUTION

3.1 PROJECT INFORMATION REQUESTS:

The Contractor shall use the procedures listed herein for obtaining project information. When Contractor finds it necessary to request additional information or interpretations of the Contract Documents, he shall request clarification in writing, using the forms or format determined by the RE.

3.2 NOTIFICATIONS:

A. The Contractor shall notify the RE ten (10) calendar days prior to beginning of each major stage of construction including:

1. Beginning demolition.
2. Removal of Antenna Shelter (Teepee).
3. Removal of Monitor Detector Antennas.
4. Removal of peripherals including junction boxes, RF box, cables, counterpoise plate and conduit.
5. Removal of the steel frame that supports the counterpoise.
6. Removal of the reinforced concrete foundations.
7. Replacement of the reinforced concrete foundations.
8. Replacement of the steel frame supporting the counterpoise.
9. Replacement of peripherals.
10. Replacement of Monitor Detector Antennas
11. Replacement of the Antenna Shelter.

B. Contractor shall notify the RE in writing ten (10) calendar days in advance of any testing required by specifications for the contractor to demonstrate to Government compliance with the applicable specifications. Notification shall state the date, time, and place where such testing will be conducted. Furnished test results shall be delivered, in writing, to the RE within seven (7) calendar days of each test. When the contractor self performs testing, test results shall be certified as true, correct, and appropriate by an independent third party competent to assess or analyze the tests.

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SECTION 01 32 01 - CONSTRUCTION SCHEDULE

PART 1 – GENERAL

1.1 SUMMARY

Promptly after award of the Contract, the Contractor shall prepare and submit to the Government estimated construction progress schedules for the work, with sub-schedules of related activities, which are essential to its progress. Revised schedules shall be submitted periodically as work progresses. The milestone dates, referred to in section 01 010 00, 1.5.A, shall be addressed in the submittal schedule.

1.2 RELATED DOCUMENTS

- A. Conditions of the Contract
- B. Summary of Work: Section 01010
- C. Submittals: Section 01 33 00

PART 2 – EXECUTION

2.1 SCHEDULE FORMAT

- A. Prepare schedules in the form of a horizontal bar chart as follows:
 - 1. Provide a separate horizontal bar for each trade or operation.
 - 2. Horizontal time scale: Identify the first workday of each week.
 - 3. Scale and spacing: Allow enough space for notations and revisions.
 - 4. Sheet size: As necessary.
 - 5. Format of listings: The chronological order of the start of each item of work.
 - 6. Identify each listing by trade name, operation or item of work with specification section numbers.
- B. The schedule shall include:
 - 1. The proposed schedule to completion.
 - 2. The actual schedule to date.

2.2 WEEKLY PROGRESS SCHEDULE

At each weekly coordination meeting present the schedule, revised as necessary, that details the proposed construction activity for the next two weeks.

- A. Schedule shall show the daily events that are planned.
- B. Schedule shall show the sub-contractors that are expected to be working at the site.
- C. Schedule shall show progress by activity as of the schedule date.

SECTION 01 32 01 - CONSTRUCTION SCHEDULE

2.3 SUBMITTAL SCHEDULE for Shop Drawings, Product Data, and Samples shall show:

- A. The dates for Contractor's Submittals.
- B. The dates approved submittals will be required from the Government.

2.4 PROGRESS REVISIONS

- A. Indicate progress of each activity to date of submission.
- B. Show changes occurring since previous submission of schedule:
 - 1. Major changes in scope (Identify approved change orders.)
 - 2. Activities modified since previous submission.
 - 3. Revised projections of progress and completion.
 - 4. Other identifiable changes.
- C. Provide a narrative report as needed to define:
 - 1. Problem areas, anticipated delays, and the impact on the schedule.
 - 2. Corrective action recommended, and its effect.

2.5 SUBMISSIONS

- A. Submit 8 copies of the initial schedule for review 10 days after contract award.
- B. Submit a revised schedule with each application for payment.
- C. Submit weekly progress schedules as required at the weekly coordination meetings.

2.6 DISTRIBUTION

- A. Distribute copies of the reviewed schedules to:
 - 1. Job site file.
 - 2. Subcontractors.
 - 3. Other concerned parties.
 - 4. The RE
- B. Instruct recipients to report promptly to the Contractor, in writing, any problems anticipated by the projections shown in the schedules.

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SECTION 01 33 00 – SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.1 SUMMARY:

- A. Furnish shop drawings, project data and samples as required by the contract documents. The following “key submittals” must be submitted at least fourteen (14) days before the pre-construction conference and must be approved **prior** to the “Notice to Proceed”. **No work “on site” shall commence until the following submittals have been approved:**

1. Construction Schedule.
2. Certified Concrete Mix Design.
3. Reinforcing Steel & Anchor Bolt Shop Drawings.
4. Construction Materials Testing Lab or independent third party test certification entities qualifications and contact data
5. Demolition & Disposal Plan
6. Safety & Health Plan
7. Plan for Dust and Erosion Control

- A. Submittals List: Submittals required include but are not limited to the following:

1. Key submittals shown in 01 33 00 1.1 A
2. Plan of Action shown in 01 14 1.3 B
3. Detailed Fall Protection Plan 01 41 00 B 1.
4. Test and Inspection Results 01 45 00 1.3 A
5. Location Plan for Temporary Facilities 01 50 00 1.3
6. Earthwork Plans 01 57 19 3.1 C
7. Erosion Control Plan 01 57 19 3.2 B
8. Products Used or Proposed 01 60 1.7 A & B
9. Close Out Submittals 01 77 00 1.2 D
10. Project Documentation 01 78 00 1.0
11. Earthwork Testing 02200 1.6 A, B, C, D, E
12. Fabrication and Erection Drawings 05 120 1.3
13. Steel Schedules & Patterns 09900 1.4 A, B, C, D

1.2 QUALITY ASSURANCE:

- A. Submittals, including shop drawings, are the Contractor's sole responsibility. Carefully examine submittals to ascertain compliance with all provisions of the specifications.
- B. Submit descriptive data, certificates, performance data, test results and other information necessary to ascertain the quality of the component and its suitability for the purpose intended. The Contractor shall make any change or adjustment in correcting work resulting from the use of such optional material or construction in conformity with the contract requirements.

1.3 SUBMITTALS:

- A. Submittals shall adhere to the procedures outlined herein. **Submittals must be complete or they will be returned without review.** Do not submit partial or incomplete information. Shop drawings are drawings, submitted by the Contractor, showing in detail (1) the proposed fabrication and assembly of structural elements, and (2) the installation (i.e., fit, and attachment details) of materials or equipment. Shop drawings may also include drawings, diagrams, layouts, schematics, descriptive literature, illustrations, manufacturer's brochures, schedules, performance and test data, and similar materials furnished by the Contractor to explain in detail specific portions of the work required by the contract. The Owner may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.
- B. Submittals shall be accompanied by an original and one copy of transmittal letter, which identifies the content of the submittals.
- C. Submit a minimum of eight (8) sets of shop drawings and/or brochures, or other submittals. Four (4) sets of shop drawings will be returned to the Contractor. Submit complete sets of indexed and bound product data.
- D. Reference to a product by trade or brand name shall not limit the Contractor from selection of another manufacturer, but if an equal is proposed, it shall be the same material, construction, color and pattern. Proposed equal products shall not be used prior to receiving RE approval.
- E. Provide submittal items as outlined in the "Submittal Checklist", located at the end of this section. Provide the RE with a copy of the completed checklist list at the end of the project.

END OF SECTION

SECTION 01 33 00 – SUBMITTAL PROCEDURES

1.4 SAMPLES:

- A. Submit samples where indicated in the specification and as requested by the RE. After review and approval by the RE, samples will be returned and may be incorporated into the construction, except that samples that are to be used to judge quality of work will be retained until the work has been completed and approved.
- B. Submit two (2) samples whenever samples are requested. Samples will be accompanied by descriptive data, specifications and certificates where necessary.

1.5 JOB CONDITIONS:

- A. Submittal data shall demonstrate that the proposed material and equipment are in compliance with the design criteria and the requirements of the Contract Documents. Submittals shall provide a record of the materials and equipment incorporated into the project and shall provide information for maintenance and repairs.
- B. Contractor shall coordinate submittals, including submittals by various trades and installers and review for accuracy, completeness, and compliance with contract requirements. Take complete and accurate field measurements for any item which must fit to field conditions. Include these dimensions on shop drawings, indicating that the measurements represent actual dimensions obtained at the site.
- C. **Submittals that do not have Contractor's approval stamp will be returned without processing.** Affix an approval stamp to each submittal stating that it has been reviewed and includes any necessary corrections, and the material contained therein is in compliance with the Contract Documents. The stamp shall have the following information:

DATE OF SUBMISSION:

Name of Project: _____

Contract No: _____

Contractor's Name: _____

Supplier's Name: _____

Manufacturer's Name: _____

Project No: _____ Submittal No: _____

Drawing No: _____ Specification Reference: _____

An "8 x 3" blank section for Government's approval stamp. Another 8"x3" blank space is needed for the contractor's stamp. Contractor's stamp is required. The contractor's stamp will include:

"This shop drawing has been reviewed and determined to be in compliance with the Contract Documents, including Plans and Specifications, as modified by Addenda, Change Orders, and Field Orders as of the date of this submittal".

Contractor's Signature: _____ Date _____

- D. Contractor is responsible to coordinate the submittals between the various trades. When a proposed component requires modification to some other part of the project, the

Contractor shall also include the revision or modifications necessary to incorporate the proposed item.

- E. The RE will indicate approval or disapproval of the shop drawings, and if not approved as submitted, shall indicate the reasons for disapproval. Work done before such approval shall be at the Contractor's risk. Approval by the RE shall not relieve the Contractor from responsibility for any errors or omissions in such submittals, nor from responsibility for complying with the requirements of this contract.

1.6 SCHEDULES:

- A. All submittals, including, samples, certificates, test reports, and shop drawings shall be submitted in ample time for Government to make a determination of compliance with the Contract Documents before fabrication and delivery to the site. Make submittals in advance of first need in ample time to allow for Government's review (30 calendar days maximum).
- B. After a submission has been approved; substitutions will not be permitted without written approval by the RE.
- C. Required submittals are listed in each section. A list of submittals is included in 01 33 00 1.1 A & B and is meant for reference only. A submittal for each item provided by the contractor must be delivered to and approved by the RE prior to the delivery of that item to the site. Identify submittals for long lead items whose submittal is critical to delivery of material. The Contractor is responsible for timely submittals. At job completion, provide the RE a completed copy of the submittal checklist.

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SECTION 01 41 00 - JOB MANAGEMENT

PART 1 – GENERAL

1.1 SUMMARY:

A. Perform administrative job related requirements necessary for the proper conduct of the work as indicated in this section and to comply with the General Conditions.

B. Related Work Covered Elsewhere:

1. Project Administration: Section 01040
2. Submittals: Section 01 33 00
3. Quality Assurance and Control: Section 01400
4. Temporary Construction Facilities: Section 01500

1.2 POLLUTION CONTROL:

A. Take necessary precautions to prevent contamination of soil, water, or atmosphere by the discharge of noxious substances resulting from construction operations. Provide equipment and personnel and perform emergency measures necessary to contain any spillage.

B. If contamination of the soil does occur, excavate contaminated soil and dispose of at a predetermined off-site location acceptable to the RE. Fill resulting excavations with suitable backfill and compact to the density of the surrounding undisturbed soil. If contamination of water sources, systems, or bodies occurs, remediation shall be performed as required by Environmental Protection laws and the cognizant authority over such matters.

C. Take measures to prevent dispersal of pollutants into the atmosphere. Do not dump or otherwise discharge noxious or harmful fluids into water bodies, drains, or sewers.

PART 2 - PRODUCTS

2.1 MATERIALS:

Materials shall be in accordance with the requirements of the individual sections of these specifications.

PART 3 – EXECUTION

3.1 FIELD MEASUREMENTS:

Contractor is responsible for making complete field measurements. Check all dimensions at the job site for components requiring fit to surrounding conditions.

Check shop drawings and indicate the actual dimensions available at all locations.

3.2 SAFETY REQUIREMENTS:

- A. Contractor is solely responsible for the safety and welfare of workmen on the project and the general public around the construction site. Take precautions to adequately safeguard the safety of all persons on or near the site. Comply with the regulations of the "Occupational Safety and Health Standards" and standards set by the government of Bermuda.
- B. Government requires **100% Fall Protection**. Whenever activities are to be performed 4 feet or higher above a lower level by the contractor or lower-tier subcontractor, the contractor shall:
 - 1. Include a detailed Fall Protection Plan as part of the Safety and Health Plan submittal. The Fall Protection Plan shall identify specific situations where fall protection is required by all contract, subcontract, and lower-tier subcontract personnel who will be engaged in activities at elevations of 4 feet or higher. The plan shall identify the fall protection system and associated components to be used, and explain the **specific methods and procedures** to be followed to assure 100% fall protection.
 - 2. Ensure employees exposed to falls of 4 feet or more are provided 100% fall protection. 100% fall protection means that the employee is protected 100% of the time by an approved fall protection system regardless of activity. **100% of the time an employee is engaged in activities at elevations of 4 feet of higher, the employee must be protected-without exception.**
- C. Provide and maintain barricades, guard rails, covered walkways, and other protective devices necessary to warn and protect the workers and general public from hazards at the construction site. Maintain barricades around open ditches or excavations. Provide barricades at roads and passageways at dangerous conditions. Provide low intensity, yellow flashing lights at such barriers at night. All barricades and protective devices shall comply with safety requirements and insurance carrier's requirements. Barricades, protective devices, and lights shall also comply with airport operations requirements.

3.3 FIRE PROTECTION:

- A. Maintain fire extinguishers at construction site in sufficient number to adequately protect the structures during construction. Provide at least one fire extinguisher at each construction office. Provide at least one fire extinguisher for welders or other trades using open flames in the execution of their work.
- B. Contractor to provide protective welders blankets and any other appropriate devices to protect the equipment building when welding is in progress above the building roof. Repair of damage to the roof caused by contractor operations will be accomplished by the contractor at no cost to the government. Repairs are subject to Government approval.

- C. Maintain the telephone number of the local fire department. Keep number posted conspicuously near telephone. The contractor shall provide his own telephone for safety and emergency use.

3.4 DISRUPTION TO SERVICES:

- A. Disruption to existing utilities, piping, or electrical services must be held to a minimum. Carefully plan work in a manner that any such disruptions are coordinated with the RE. Any operation, which requires shut down of some portion of the facility's operation must be in compliance with Section 01030, "Special Provisions."
- B. Unintended interruption of services shall be repaired immediately.

3.5 MAINTENANCE OF WATER:

- A. Manage water at the job site at all times during construction. Furnish all equipment and perform any operations required to remove water from any part of the construction area as necessary to permit the proper installation of the work.
- B. Provide well points or other acceptable methods to remove water as required. Maintain excavations entirely clear of water during demolition and construction activities. Fresh concrete shall be adequately protected from injury resulting from rain, ground water, or handling or disposal of water.
- C. Direct water away from the site in a manner that prevents ponding re-occurrence or that causes water to run onto adjacent property. Water must not be directed into the nearby ocean without proper approval and safeguards required by Bermuda and Environmental Protection Agency regulations. Drainage ditches must be approved by the RE. In the event that water from this site results in flooding or other damage to adjacent property, Contractor shall be responsible to repair damage or make payment to the affected land Owner.
- D. Maintain ditches and embankments necessary to protect open trenches or other excavations. Provide pumps to maintain excavations free of water. In the event water table must be lowered to maintain excavations in a dry condition, provide well points or other procedures necessary and operate such pumps until backfill has been completed.
- E. Maintain erosion control hay bale barrier or an approved substitute around the construction site for the duration of the project as indicated on the construction drawings and as necessary to control soil erosion.

3.6 BLASTING:

Blasting is not anticipated. No blasting will be permitted at this site, unless first approved in writing by the Government.

3.7 WEATHER PROTECTION:

- A. Structure: Provide and maintain winter and weather protection to protect all parts of the structure and contents from damage by the elements, and to enable necessary concrete and other work to proceed in cold weather.
- B. Wall Openings: Creations of wall openings is not part of this contract.

3.8 SLEEVES AND EQUIPMENT BASE: Not Used

3.9 ORDER OF PRECEDENCE:

- A. Contractor shall coordinate work in a manner to avoid conflicts or interference among trades. Lay out work in advance of installation to ascertain location of various systems and arrangement of piping and conduit. Coordinate work and take action as necessary to avoid conflicts between the various trades. Establish the exact locations of equipment based on actual dimensions of the items furnished.
- B. Contractor shall coordinate with and cooperate with all other contractors who may have projects on-going simultaneously on the site or that may use the same access routes or facilities.

3.10 CONSTRUCTION SUBCONTRACTOR MANAGEMENT

Contractor shall provide a construction superintendent who shall be an employee of the contractor who shall be on-site at all times to supervise all work being performed by contractor and subcontractor personnel.

END OF SECTION 01 41 00

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SECTION 01 45 00 - QUALITY CONTROL

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for quality-control services.
- B. Quality control services include inspections, tests, test certifications, and related actions, including reports performed by Government, Contractor, independent agencies, and governing authorities.
- C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.
- D. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.
 - 1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified inspections, tests, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with Contract Document requirements.

1.2 RESPONSIBILITIES

- A. Contractor Responsibilities: Unless otherwise indicated as the responsibility of another identified entity, Contractor shall provide inspections, tests, and other quality-control services specified in the Contract Documents and as required by authorities having jurisdiction. Costs for these services are included in the Contract Sum. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Contractor's responsibility, the Contractor shall employ and pay a qualified persons to perform testing and quality control functions. Costs for these services shall be included in the Contract Sum. All contractor controlled tests must be certified by a third party agency licensed in Bermuda to provide such services.
- B. Retesting: The Contractor is responsible for retesting where results of inspections, tests, or other quality-control services prove unsatisfactory and indicate noncompliance with Contract Document requirements. Failure to obtain third-party certification constitutes test failure. The cost of retesting construction, revised or replaced by the Contractor, is the Contractor's responsibility where required tests performed on original construction indicated noncompliance with Contract Document requirements.
- C. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable associated services as requested. Notify the agency

sufficiently in advance of operations to permit assignment of personnel. Associated services required include, but are not limited to, the following:

1. Provide access to the Work.
 2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
 3. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
 4. Provide facilities for storage and curing of test samples.
 5. Deliver samples to testing facilities.
 6. Perform testing.
 7. Provide security and protection of samples and test equipment at the Project Site.
- D. Duties of the Testing Agency: The contractor is the testing agency. Contractor shall perform inspections, sampling, and testing of materials and construction specified in individual sections. Testing shall be provided by qualified personnel to perform required inspections and tests.
1. Contractor shall notify the RE promptly of irregularities or deficiencies observed in the Work during testing.
 2. Third-Party Quality Control certification agencies are not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work. Third-Party certification agencies certify acceptable test results.
 3. Certifying agencies shall provide the Contractor and the RE all reasons for any refusal to certify the contractor's test results.
- E. Coordination: Coordinate the sequence of activities to accommodate required services with a minimum of delay. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests. The Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.

1.3 SUBMITTALS

- A. The independent testing certification agency shall submit, through the Contractor, a certified written report, in duplicate, of each inspection, test, or similar service to the RE. Written reports of each inspection, test, or similar service include, but are not limited to, the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of both the testing agency and the third-party certification agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of certifying official and of individuals making the inspection or test.
 6. Designation of the Work and test method.
 7. Identification of product and Specification Section.
 8. Complete inspection or test data.

9. Test results and an interpretation of test results.
10. Ambient conditions at the time of sample taking and testing.
11. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.
12. Recommendations on retesting.

1.4 QUALITY ASSURANCE

- A. Qualifications for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, or certifying agencies that are pre-qualified as complying with the American Council of Independent Laboratories' (ACIL) "Recommended Requirements for Independent Laboratory Qualification" or the Bermuda equivalent and that specialize in the types of inspections and tests to be performed.
- B. Each independent inspection, testing and certifying agency engaged on the Project shall be authorized, by authorities having jurisdiction, to operate in the country of Bermuda.

PART 2 - PRODUCTS (Not Applicable)

PART 3 – EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: Upon completion of inspection, testing, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
- B. Protect work exposed by or for quality-control service activities, and protect repaired construction.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION 01 45 00

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SECTION 01 50 00 - TEMPORARY FACILITIES

PART 1 – GENERAL

1.1 SUMMARY

Furnish all temporary facilities, including field offices, storage sheds, and temporary utilities required for the duration of the Work.

1.2 JOB CONDITIONS

- A. Determine exact location of buildings and sheds at the job site, subject to approval of RE. Site preparation will be minimal. After getting required approvals, remove any trees, brush, and debris necessary to provide space for demolition and construction. Perform demolition or grubbing needed to clear a space adequate for the work.
- B. Establish, pay for, and remove at the end of project, all temporary facilities.

1.3 SUBMITTALS

Submit location plan of temporary facilities to the RE for approval.

PART 2 - PRODUCTS

2.1 FIELD OFFICES

- A. Furnish and maintain a field office for the use of Government's RE. The field office shall be approximately 200 square feet in size (about 8' x 26'). Space shall be continuous (separate trailers are unacceptable). The trailer is to be equipped with the following features:
 - 1. Steps
 - 2. Outside door with a dead bolt lock.
 - 3. HVAC System with the following:
 - a. Maintain a minimum temperature of 80 degrees F at an ambient outdoor temperature of 20 degrees F.
 - b. Maintain a maximum temperature of 75 degrees Fahrenheit at an ambient outdoor temperature of 105 degrees Fahrenheit.
 - 5. Security lighting: Dual flood lights activated by a motion detector on the front and back sides of the office.
 - 6. Windows
 - 7. Furnished as follows:
 - a. (2) Desks with built-in file drawers
 - b. (3) Swivel chairs with rollers
 - c. (1) Plan layout or drafting table with chair
 - d. (1) 6 ft. high book shelf
 - e. (3) waste paper baskets
 - f. (1) hanging plan rack capable of hanging 10 sets of drawings

- g. (1) 3-drawer file cabinet
- h. (1) Drinking water dispenser with cups

- B. Contractor shall provide and maintain a separate field office to be occupied by his authorized representative. The Contractor's authorized representative shall be present at all times while work is in progress. Instructions received there shall be considered as delivered to the Contractor.
- C. Provide all utilities necessary. Make connections to the office and pay for utilities during construction. The Government will pay for its use of the telephone services.
- D. Contractor shall be responsible for providing an adequate supply of potable water for use in the field offices.

2.2 TEMPORARY STRUCTURES AND STORAGE BUILDINGS:

- A. Contractor shall furnish, erect, and maintain all necessary temporary barricades required to provide adequate protection for all personnel, materials, equipment, and structures throughout the project.
- B. Provide a temporary portable storage container/trailer for storage of Government Furnished Equipment (GFE), if any, not requiring conditioned space. Storage for the antennas and antenna shelter (teepee) shall be at a designated government facility. The storage trailer shall be a standard ISO steel shipping container, with minimum exterior dimensions of 8' x 8' x 40'. The trailer shall be watertight with no holes in the exterior. The trailer doors shall be of heavy construction with theft resistant locking mechanisms.

2.3 TEMPORARY SANITARY FACILITIES:

- A. Provide portable sanitary facilities at the job site from the commencement of the project to its conclusion. Maintain facilities in clean and sanitary conditions at all times.
- B. These sanitary facilities shall be provided for the use of all personnel employed on the work of the contract. Portable toilets shall be maintained and cleaned on at least a weekly basis.

2.4 TEMPORARY UTILITIES:

- A. Provide temporary utilities required by trades during construction, including electrical power, water, and telephone (The contractor shall provide telephone for emergency use throughout the construction period).
- B. Provide a source of temporary electrical power for the construction procedures. Comply with OSHA and Power Company requirements. Provide extensions to the various parts of

the building. Provide junction boxes so that distribution boxes are available within 75 ft. of any part of the structure.

2.5 TEMPORARY LIGHTING:

If power is locked out and tagged out in the building, provide temporary lighting inside the building. Provide adequate lighting to perform work within a space. Leave lights in position in such a manner that every space has light at all times. Remove temporary lights once permanent power is returned to service.

PART 3 - EXECUTION

3.1 LOCATION OF TEMPORARY FACILITIES:

Submit for approval the location for all temporary facilities as well as parking/staging/storage areas. Locate facilities in an area that will not interfere with any work to be performed under this Contract. Location must be acceptable to the RE. Parking for employee vehicles will not be provided.

3.2 REMOVAL OF TEMPORARY FACILITIES:

At the conclusion of the Project, remove temporary buildings, sheds, and utilities. Complete remainder of site work to return the site to a condition as good as or better than existed before the construction.

END OF SECTION 01 50 00

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SECTION 01 51 00 - GRADES, LINES, AND ELEVATIONS

PART 1 – GENERAL

1.1 SUMMARY

- A. Government will indicate benchmark(s) to be used.
- B. Contractor shall establish all other lines and grades in accordance with the Drawings and Specifications based upon the benchmark(s) provided. The Contractor shall provide a land surveyor, registered in the locality of the site, to lay out the work and to provide other necessary services to complete the work as scheduled.
- C. Surveyor shall locate the Alfred Loop Antennas and each monitor detection antenna (MDA) with respect to azimuth and elevation so that each MDA can be returned precisely to its former position.
- D. Survey records shall become the property of the Government once construction is complete.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide all instruments, rods, measures, stakes, ribbons, nails, and all other materials and equipment to perform the work of this section.
- B. Measuring and marking equipment shall remain the property of the contractor or surveyor as appropriate.

PART 3 – EXECUTION

3.1 INSPECTIONS

- A. Carefully examine the Drawings and immediately report to the Engineer any error, apparent discrepancy in the data shown, or omissions of data required to accurately accomplish the work.
- B. Carefully examine the project site and locate any bounds, survey marks or benchmarks in the vicinity of the work. Should items shown on the Drawings as existing not be found, notify the Engineer.

3.2 TRUE NORTH REFERENCE POINT

- A. The contractor shall establish true north, mark true north on the counterpoise, and install a bronze plaque identifying true north once the new counterpoise structure is in place.
- B. Contractor shall also establish and mark magnetic north on the new counterpoise structure.

3.3 LAYOUTS

- A. Establish any additional baselines which may be required to locate the work and provide suitable, adequate and sufficient number of benchmarks, MDA location references, slope stakes, batter boards, and other required control and reference points.
- B. Perform all required surveys and accurately lay out the Work.

3.4 FIELD NOTES, TIES AND COMPUTATIONS

- A. Make all computations necessary to establish the exact position of the work. Maintain field notes of all ties, baselines, reference points, benchmarks, and other control points. Also maintain field notes of all data required to be shown on the record drawings.
- B. Prior to any work in the vicinity of an existing property monument or marker, provide at least 4 ties to physical objects which will not be damaged, destroyed or disturbed in the course of the work. Ties must be sufficient to re-establish a displaced monument.

3.5 REFERENCE MONUMENTS

- A. Contractor shall maintain all established bounds and benchmarks and replace, as directed, any which may be destroyed or disturbed as a result of his operations.
- B. All grades, elevations, and control points shall be established off of a benchmark provided on the construction drawings.

END OF SECTION 01 51 00

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SECTION 01 54 00 – SECURITY

PART 1 – GENERAL

1.1 PROTECTION OF PERSONS

- A. The Contractor shall take all necessary precautions for the safety of employees and other persons at the work place, and shall comply with all applicable provisions of Federal, State, and Local safety laws and building codes to prevent accidents or injury to all persons on, about, or adjacent to the premises where the work is being performed. The Contractor shall comply with all pertinent provisions of "OSHA Safety and Health Standards for the Construction Industry".
- B. The Contractor shall provide and maintain during the life of the Contract all legal and necessary guards, barricades, railings, bracing, shoring, scaffolding, bridges, roofs, lights, warning signs, and similar protection equipment required to fully protect all persons from loss, damage, or injury either to their persons or property and as required to safely and properly maintain traffic on public ways and reasonable access to property. The Contractor shall post signs warning against the dangers created by such hazards as protruding nails, hoists, holes, hatchways, scaffolding, window openings, stairways, and falling materials.
- C. Contractor shall provide all special protection equipment required for the work, such as respirators, goggles, ventilators, etc.
- D. Whenever chipping, cutting, coring, welding, or similar operations are being performed overhead, it is mandatory that effective barricades and protective devices be erected beneath to prevent injury to persons or property or fire from falling debris. Portable fire extinguishers shall be located and maintained by the Contractor about the work area for emergency use.
- E. Contractor shall restrict the presence of his employees and subcontractors to the immediate work area and the access road area. Employees shall successfully complete all training for movement of personnel about the airport property.
- F. Equipment or vehicles entering or leaving the site or using public ways shall obey all traffic regulations. Where visibility is impaired, the Contractor shall assign a person to direct movement of his vehicles to assure safe operation. In the event construction requires closure of a lane/roadway, arrangements shall be made in advance with Airport security police and the RE in order to ensure safety.

1.2 PROTECTION OF PROPERTY

- A. Contractor shall make good any injury to the Owner's property or that of neighboring properties, which may result from operations under this Contract.
- B. Contractor shall furnish and set all temporary roofs, boxes, and other constructions necessary to protect the work. Any work injured during the construction period from any cause shall be made good by the mechanic who furnished or installed it. Such repairs shall be

made at no cost to the Government, except where the Engineer determines that the Government, its employees, or another contractor employed by the Government caused the damage.

C. During the construction period, special precautions shall be taken to prevent and control fire hazards. When the use of open flames and welding or cutting by torch is planned, prior permission shall be obtained from the RE, shields shall be used, and fire extinguishers shall be provided. Tarpaulins shall be of the flameproof type. Emergency protection in the form of extinguishers, water pails, and small hose streams shall be provided by the Contractor as needed. Storage and use of combustible materials shall be kept at a minimum and shall be safeguarded at all times.

D. Proper environmental procedures shall be followed in the disposal of any hazardous wastes.

1.3 PROTECTION OF COMBUSTIBLE MATERIAL

Wherever lumber, wood staging, planks, or other combustibles are used, provide suitable and approved fire extinguishers.

END OF SECTION 01 54 00

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SECTION 01 55 00 - FURNISHED EQUIPMENT

PART 1 – GENERAL

1.1 EQUIPMENT FURNISHED BY GOVERNMENT (GFE)

A. The equipment and materials listed below will be Government Furnished Equipment (GFE) and are in place at the site:

1. Fiberglass DME/VOR Antenna Shelter (Removed & Re-installed)
2. Alfred loop, DME, and Monitor Detector Antennas
3. Antenna Leveling plate
4. Obstruction Light

B. Items listed below are to be removed carefully, stored appropriately, and re-installed once the new counterpoise frame is in place:

1. VOR and DME antenna shelter
2. Sixteen Monitor Detector Antennas with Brackets
3. Antenna Leveling Plate
4. RF Box, MDA Boxes, and Junction Boxes
5. Ladder

1.2 GOVERNMENT RESPONSIBILITIES

A. Arrange for and deliver necessary GFE assembly and erection drawings, catalog cuts, specification sheets and related documents to the Contractor.

B. Arrange for and pay for GFE delivery to the site if necessary.

C. Deliver bill of materials to contractor.

D. Inspect deliveries jointly with contractor and arrange for replacement of damaged, defective or missing items.

E. Submit claims for transportation damage.

F. Arrange for GFE manufacturers' warranties, bonds, service and inspections, if applicable.

1.3 CONTRACTOR'S RESPONSIBILITIES

- A. Review assembly and erection drawings and product data. Promptly notify RE of any discrepancies.
- B. Receive and unload GFE at the site. Provide all lifting devices required to accomplish unloading of GFE.
- C. Promptly inspect GFE with Resident Engineer, record shortages, damaged or defective items.
- D. Sign, date and deliver to the Engineer itemized "Material Receipts" for all materials and equipment, which are to be erected/installed by the Contractor
- E. Provide proper equipment and skilled personnel to move, handle, and uncrate, where required, equipment or material of this size, weight and type. Remove and dispose of all crates and packing materials
- F. Protect GFE from exposure to elements, damage, pilferage and vandalism
- G. Assemble, install, connect and adjust GFE, as stipulated in the specifications
- H. Repair or replace items damaged as a result of the work of this contract.

1.4 DELIVERY OF GOVERNMENT FURNISHED EQUIPMENT

All GFE is on site. Delivery by the Government is not anticipated.

END OF SECTION 01 55 00

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SECTION 01 55 26 – MAINTENANCE OF TRAFFIC

PART 1 - GENERAL

1.1 SUMMARY

A. Existing Facility Operations: For construction on or in the immediate vicinity of the Airport, it will be necessary to coordinate all construction activity so as not preclude interference with airport operations. The Contractor shall perform all work with a minimum disruption to the DAO operations. This coordination shall be conducted through the Resident Engineer's office and include written notification. Notification documents will be made available to the Airport Manager, Air Traffic Control Tower, and other contractors at least two weeks prior to commencement of work.

B. Construction Limits and Access:

1. Construction Limits: The Contractor shall confine operations, activities, storage of materials within the designated areas shown on the construction drawings. Additional space the Contractor deems necessary shall be obtained off site, at no additional cost to the Government.
2. Access to the Site shall be as indicated on the drawings. The contractor shall maintain the security integrity of the site at all times. Any existing access roads including surface course, grading, and erosion protection shall be maintained by the Contractor throughout the Contract term and be brought to pre-construction conditions at the time of final inspection.
3. Damage to Site: Damage to existing paving, lawns, curbs, or improvements as a result of Contractor's activities shall be repaired. All costs of repairs shall be paid by the contractor. After notice to proceed and prior to the commencement of construction, the contractor and RE shall conduct joint inspections of the existing areas affected by the construction. Existing damage or defects shall be noted and will be used as the basis for determination of damages caused by the Contractor's operations.

C. Inspection of Site by Contractor.

The Contractor shall have carefully examined the premises to determine the extent of work and the conditions under which it must be done. On request to and approval from the Government the Contractor may obtain permission to make soil borings or probings.

D. Contractor's Use of Premises.

Contractor shall have complete and exclusive use of the premises within the construction staging areas limits for the execution of the work; however, Contractor will not unlimited access inside the equipment or transformer buildings. Contractor shall assume full responsibility for the protection and safekeeping of products, including Government Furnished Equipment, stored on the site. The Contractor and subcontractors shall maintain the job site in

a neat and orderly condition. This includes the daily removal of rubbish, waste and tools, equipment and materials not required for the work in progress. Normal work hours at the airport shall be from **7:00 AM to 4:00 PM**, Monday through Friday, except holidays. If weekend or evening work is required, requests must be filed in writing with the RE 4 days in advance. The RE has the right to refuse the Sunday morning work request for personal reasons. Approval for work outside of normal work hours is not guaranteed.

F. Security & Safety Requirements.

1. Personnel List: Contractor shall provide the RE with a list of contractor's personnel who will require access to the site. The list shall be kept current during project work. The Contractor shall provide all personnel with readily identifiable numbered badges during the period their access to the on-site location is required. The badges shall be worn on outer clothes at all times on the site.
2. Security Investigation: Contractor's personnel may be subject to security investigation by the Government. Upon request by airport security, the contractor shall promptly complete all security forms provided to them.
3. Vehicle Insurance: All vehicles that will be entering the premises must provide a Certificate of Insurance to the local Department of Aviation. Contractor shall verify all motor vehicles in use on airport property are insured.
4. Right to Search: If in the judgment of airport security, a cause to search a vehicle or person exists, such a search will be made.
5. FAA Safety Guidelines: For all airside work, Contractor shall comply with the applicable portions of the following FAA Advisory Circulars, which may be found on the internet at [http://www.airweb.faa.gov/Regulatory and Guidance, Library/rgAdvisoryCircular.nsf/Mainframe?OpenFrameSet](http://www.airweb.faa.gov/Regulatory%20and%20Guidance/Library/rgAdvisoryCircular.nsf/Mainframe?OpenFrameSet):
 - i. AC No. 150/5210-5B – Painting, Marking, and Lighting of Vehicles Used on an Airport
 - ii. AC No. 150/5210-20 – Ground Vehicle Operations on Airports
 - iii. AC No. 150/5370-2E – Operational Safety on Airports During Construction

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SECTION 01 57 19 – TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 – GENERAL

1.1 DESCRIPTION

Provide all work for the prevention of environmental pollution during and as a result of work specified in other sections of these specifications.

1.2 REQUIREMENTS OF REGULATORY AGENCIES

Comply with all applicable Federal, State, and local laws and regulations concerning environmental pollution control and abatement including protection of wetlands and streams; protection of beaches, protection of the ocean, and the control of construction run-off.

PART 2 - PRODUCTS (Not Applicable)

PART 3 – EXECUTION

3.1 PROTECTION OF LAND RESOURCES

- A. General: Insofar as possible, the Contractor shall confine his construction activities to areas defined by the drawings and specifications.
- B. Restoration of Landscape Damage: In the event any landscape feature is scarred or damaged by equipment or operations, the Contractor shall notify the RE of the disturbance and the Contractor shall restore feature as nearly as possible to its original condition, or replace the landscape feature, as approved by the RE.
- C. Temporary Excavation and Embankments: If the Contractor proposes to construct temporary roads or embankments and excavations for plant work areas, other than that indicated, he shall submit the following for approval at least thirty (30) days prior to scheduled start of such temporary work.
 - 1. A layout of all temporary roads, excavations, and embankments to be constructed within the work area.
 - 2. Plans and cross sections of proposed embankments and their method of stabilization, including a description of proposed materials.
- D. Post-Construction Cleanup or Obliteration: The Contractor shall obliterate all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, or any other vestiges of construction caused by work under this Contract.

3.2 PROTECTION OF WATER RESOURCES

- A. General: Do not pollute streams, lakes the ocean or reservoirs with fuels, oils, bitumen, calcium chloride, acids or harmful materials. It is the responsibility of the Contractor to investigate and comply with all applicable Federal, State, County, Local Government, and Municipal laws concerning pollution of water bodies. All work under this Contract shall be

performed in such a manner that objectionable conditions will not be created in or near bodies of water adjacent to the project areas.

- B. Erosion Control: Prior to any major construction, the Contractor shall submit a plan for approval showing his scheme for controlling erosion and disposing of wastes.

3.3 DUST CONTROL

The Contractor shall be required to maintain all excavations, embankments, stockpiles, access roads, waste areas, borrow areas, and all other work areas within or without the project boundaries, free from dust which would cause the standards for air pollution to be exceeded, which will adversely impact airport operations, or which would cause a hazard or nuisance to others. Approved temporary methods of stabilization consisting of sprinkling, chemical treatment, light bituminous treatment, or similar methods will be permitted when used in accordance with local regulations, to control dust. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor must have sufficient competent equipment on the job to accomplish this if sprinkling is used. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs.

3.4 MAINTENANCE OF POLLUTION FACILITIES DURING CONSTRUCTION

Maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out, or until the material concerned has become stabilized to the extent that pollution is no longer being created.

3.5 NOISE ABATEMENT

The Contractor shall comply with all applicable Federal, State, and local laws on noise abatement. The Contractor's equipment shall be equipped with proper exhaust silencers as required by law.

3.6 RECORDING AND PRESERVING HISTORICAL AND ARCHAEOLOGICAL FINDS

Any discovery of apparent historical or archaeological interest shall be reported immediately to the RE so that the Owner may be notified. Construction operations will be halted temporarily until a decision can be made as to the authenticity of such discoveries and what disposition is desired.

END OF SECTION 01 57 19

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SECTION 01 60 00 - MATERIAL AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Material and equipment incorporated into the Work shall:
 - 1. Conform to applicable specifications and standards.
 - 2. Comply with size, make, type and quality specified, or as specifically approved in writing by the Government.
 - 3. Manufactured and Fabricated Products:
 - a. Design, fabricate and assemble in accord with the best engineering and shop practices.
 - b. Manufacture like parts of duplicate units to standard size and gauges, to be interchangeable.
 - c. Two or more items of the same kind shall be identical, by the same manufacturer.
 - d. Products shall be suitable for service conditions.
 - e. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
 - 4. Do not use material or equipment for any purpose other than that for which it is designed or is specified.
- B. Related requirements in other parts of the Project Documents:
 - 1. Meet Conditions of the Contract.
 - 2. Meet drawing requirements
- C. Related requirements specified in other sections:
 - 1. Summary of Work - Section 01010
 - 2. Submittals - Section 01 33 00
 - 3. Project Record Documents - Section 01730

1.1 REUSE OF EXISTING MATERIAL

- A. For material and equipment specifically indicated or approved to be reused in the Work:
 - 1. Use special care in removal, handling, storage and reinstallation, to assure proper function in the completed work.
 - 2. Arrange for transportation, storage and handling of products, which require on-site or nearby storage.

1.3 MANUFACTURER'S INSTRUCTIONS

- A. Arrange deliveries of products in accordance with construction schedule, coordinate to avoid conflicts with work and conditions at the site.
 - 1. Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
 - 2. Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals, and that products are properly protected and undamaged.
- B. Provide equipment and personnel to handle products by methods that prevent soiling or damage to products or packaging.

1.4 STORAGE AND PROTECTION

- A. Store products in accord with manufacturer's instructions, with seals and labels intact and legible.
 - 1. Store products subject to damage by the elements in weather tight enclosures.
 - 2. Maintain temperature and humidity within ranges required by manufacturer's instructions.
- B. Exterior Storage
 - 1. Store fabricated products above the ground, on blocking or skids, prevent soiling or staining. Cover products, which are subject to deterioration with impervious sheet coverings, provide adequate ventilation to avoid condensation.
 - 2. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.
 - 3. The Contractor shall provide space for storage of material and equipment at ground level. No roof surface shall be used for storage.
 - 4. Locate all combustible materials 50 feet from any existing building, new construction or both.

C. Flammables

1. All flammable liquids such as gasoline, paint and cleaners must be removed from the site daily.
2. All flammable liquids must be stored in metal cabinets or boxes conforming to NFPA Pamphlet No. 30, Sections 4220, 4221, and 4222 and shall be dispensed from approved safety cans.
3. Mount and maintain, immediately outside the door to this storage area, a UL listed 2A-20BC rated multipurpose dry chemical or a UL listed 10BC rated carbon dioxide fire extinguisher.
4. Keep this storage area clean and remove all trash immediately.

D. Protection after installation

1. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations.
2. Remove coverings when no longer needed.

1.5 REJECTION OF MATERIALS

- A. Damaged or deteriorated material shall be discarded and removed from the premises.
- B. Under no circumstances is damaged material to be installed.

1.6 REPLACEMENT

- A. In the event of damage, immediately make all repairs and replacement necessary to the approval of the RE and at no additional cost to the Government.
- B. Repairs or replacement must meet requirements of the drawings and specifications.

1.7 SUBSTITUTION AND PRODUCT OPTIONS

A. Product List

1. Within 60 days after Notice to Proceed date, submit to the Government a complete list of major products proposed to be used.
2. List to include the name of the manufacturer or fabricator and the installing subcontractor.

B. Contractor's Options

1. For products specified only to a reference standard, select any product meeting that standard.
2. For products specified by naming several products or manufacturers, select any one of the products or manufacturers, Contractor must submit a request as for substitutions for any product or manufacturer not specifically named.
3. The reference to a product by a trade or brand name herein or on the contract drawings shall not limit the contractor from selection from other manufacturer's but if an equal is proposed or selected, it shall be the same material, construction, and similar color pattern.

C. Substitutions

1. For a period of 60 days after "Notice to Proceed" the Government will consider written requests from the Contractor for substitution of products.
2. Submit a separate request for each product, supported with complete data, with drawings and samples as appropriate, including:
 - a. Comparison of the qualities of the proposed substitution with that specified.
 - b. Changes required in other elements of the work because of the substitution.
 - c. Effect on the construction schedule.
 - d. Cost data comparing the proposed substitution with the product specified.
 - e. Any required license fees or royalties.
 - f. Availability of maintenance service, and source of replacement materials.
3. The Government shall be the judge of the acceptability of the proposed substitution.

D. Contractor's Representation

1. A request for a substitution constitutes a representation that the Contractor:
 - a. Has investigated the proposed product and determined that it is equal to or superior in all respects to that specified.
 - b. Will provide the same warranties or bonds for the substitution as for the product specified.
 - c. Will coordinate the installation of an accepted substitution into the work, and make such other changes as may be required to make the work complete in all respects.
 - d. Waives all claims for additional cost, under his responsibility, which may subsequently become apparent.
2. Incomplete or inaccurate representations will be cause for denial of the substitution.

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SECTION 01 65 10 - INSTRUCTIONAL CLASSES – NOT REQUIRED

END OF SECTION 01 65 10

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SECTION 01 74 13 - CONSTRUCTION CLEANING

PART 1- GENERAL

1.1 SUMMARY:

- A. Just prior to occupancy of the site by the Government, perform a thorough cleaning of the site, buildings in which the contractor worked and of the structures constructed in this contract.
- B. Related Work Covered Elsewhere:
 - 1. Project Administration Section 01040
 - 2. Job Management Section 01041
 - 3. Temporary Construction Facilities Section 01500

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Furnish materials and equipment needed for cleaning and waxing purposes. Use cleaners and waxes recommended by the manufacturer for the individual material.
- B. Furnish material safety data sheets with the products.

PART 3 - EXECUTION

3.1 SITE CLEANING:

- A. Maintain site in clean condition at all times. At the end of each workday, gather all loose trash and debris from around site and place in trash containers or remove from site. Do not stack trash or other construction debris on the ground or in the open. Place trash in closed containers. Do not allow trash or debris to become airborne; blow around or blow off site.
- B. The contractor shall prevent foreign objects and debris from entering the runway and taxiway safety areas.

3.2 ROUTINE CLEANING:

- A. Routinely clean buildings and construction trailers to remove all construction debris, packing crates, wrappings, packing materials, or other trash. Each trade is responsible to remove trash and debris resulting from its operations. Construction trailers shall be cleaned weekly.
- B. Maintain a heavy duty building construction paper on the floor of the equipment building that is equal to or better than that of red rosin quality.
- C. Maintain entire space of buildings in a broom clean condition at all times. After installation of new cables, thoroughly clean spaces of trash and debris, sweep floors clean and mop to remove dust.

3.3 FINAL CLEANING:

- A. Thoroughly clean the site and make ready for occupancy and operations. Remove construction debris, boxes and trash. Clean entire site, removing all trash from the site. Remove construction storage sheds and field offices and restore grade to match surrounding conditions. Remove excess dirt and complete site work.
- B. Clean counterpoise and inspect for damage. Replace damaged plate and missing fasteners.
- C. Clean wall surfaces to remove dirt or scuff marks caused during cable pulling.
- D. Inspect all exterior painted surfaces. Spot paint any surfaces damaged by the construction.

END OF SECTION 01 74 13

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SECTION 01 77 00 – CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Comply with requirements stated in Conditions of the Contract and in Specifications for administrative procedures in closing out the Work.
- B. Related requirements specified in other sections:
 - 1. Cleaning: Section 01710
 - 2. Record Documents: Section 01730
 - 3. Warranties and Bonds: Section 01740
 - 4. Closeout Submittals required of Trades: The respective sections of Specifications.

1.2 FINAL INSPECTION

- A. When Contractor considers the Work is complete, he shall submit written certification that:
 - 1. Contract documents have been reviewed.
 - 2. Work has been inspected for compliance with Contract Documents.
 - 3. Work has been completed in accordance with Contract Documents.
 - 4. Equipment and systems have been tested in the presence of the RE and are operational.
 - 5. Work is completed and ready for final inspection.
- B. RE will make an inspection to verify the status of completion with reasonable promptness after receipt of such certification.
- C. Should RE find that the Work is incomplete or defective:
 - 1. Contractor shall take immediate steps to remedy the stated deficiencies, and send a second written certification to RE that the Work is complete.
 - 2. RE will re-inspect the Work.
- D. When the RE finds that the Work is acceptable under the Contract Documents, he shall request the Contractor to make closeout submittals, and schedule final close out inspection.

1.3 CONTRACTOR'S CLOSEOUT SUBMITTALS TO THE GOVERNMENT

- A. Evidence of compliance with requirements of governing authorities include Certificates of Inspection and;
- B. Project Record Documents: To requirements of Section 01730; and
- C. Warranties and Bonds: To requirements of Section 01740; and
- D. Spare parts and maintenance materials: see requirements of other Sections.

1.4 FINAL APPLICATION FOR PAYMENT

- A. Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in Conditions of the Contract.
- B. Payment will be processed by the FAA in a timely manner.

END OF SECTION 01700

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SECTION 01 78 00 - OPERATION AND MAINTENANCE MANUALS

1.0 PROJECT RECORD DOCUMENT SUBMITTALS

A. General: Maintain at the site for the Government the specified two record copies of each of the following:

1. Red-line Drawings
2. Red-line Specifications
3. Addenda
4. Change Orders and Clarifications
5. Test Reports
6. Approved Submittals and completed Submittal Checklist.
7. As-Built survey information for counterpoise elevation, for location of true north, and for location of magnetic north. Deliver these documents to the RE at construction completion. Do not use record documents for construction purposes. Protect record documents from deterioration and loss in a secure location. Provide access to record documents for the RE's reference during normal working hours.

B. Red-lined Drawings: Maintain two clean, undamaged sets of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the sets in red pen or marker to show the actual installation where the installation varies substantially from the Work as originally shown. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Mark record sets with red pen or marker.
2. Mark new information that is important to the Government but was not shown on Contract Drawings or Shop Drawings.
3. Include all change orders (Clarifications) and note related change-order numbers where applicable.
4. Organize record drawing sheets into manageable sets. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on the cover of each set.
5. Upon completion of the Work, submit two sets of red-lined drawings to the RE for the Government's records.

C. Record Specifications: Maintain one complete copy of the Project Specifications, including Addenda. Include in a Project Manual one copy of all project record documents and other written construction documents, such as Change Orders and modifications issued in printed form during construction.

1. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications.
2. Give particular attention to substitutions and selection of options and information on concealed construction that cannot otherwise be readily discerned later by direct observation.

3. Note related record drawing information and Product Data.
4. Upon completion of the Work, submit two copies of record Specifications to the RE for the Government's records.

END OF SECTION 01 78 00

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SECTION 02050-DEMOLITION AND REMOVAL

PART 1-GENERAL

- 1.1 Scope: Demolition and removal of the VOR counterpoise steel supporting structure and foundations are to be accomplished. Replacement of the supporting foundations, steel structure, and supported items will follow successful demolition. The supporting structure is structural steel. The foundations are reinforced concrete pedestals (piers) and footings. Demolition and removal shall not start prior to submission and approval of Contractor's Demolition and Removal Plan. Procedures in the Demolition and Removal Plan shall provide safe conduct of the work, careful removal and disposition of the materials specified to be salvaged or re-incorporated in the work, protection of property which is to remain undisturbed, coordination with other work in progress, and a schedule for timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation and the sequence of operations. Include statements affirming Contractor inspection of existing conditions and the suitability of the site to engage in the work safely. If inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work.
- 1.2 REFERENCES: The current issues of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.6 Demolition Operations - Safety Requirements

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 61-SUBPART M National Emission Standard for Asbestos

PART 2 – PRODUCTS: Not used.

PART 3 - EXECUTION:

3.1 General: Demolition and removal work shall comply with federal, state, and local demolition, hauling, and disposal regulations. Demolition and removal work shall be in compliance with approved demolition procedures and applicable requirements of agencies having jurisdiction. In addition to the requirements of the "Contract Clauses," safety requirements shall conform with ANSI A10.6.

3.2 Protection of Existing Work: Before beginning any cutting or demolition, the Contractor shall carefully survey the existing work and examine the drawings and specifications to determine the extent of the work. Protect existing work which is to remain in place, be reused, or remain the property of the Government. Repair, at no additional cost to the Government, to original condition items which are to remain or are to be salvaged or reused and which are damaged during performance of the work, or replace with new. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal work. Repairs, reinforcement, or structural replacement must have approval from the RE/COR. Contractor shall carefully coordinate the work of the division with all other work and construct and maintain any necessary protective structures.

- A. Dust Control: Prevent the spread of dust and debris beyond the demolition or renovation area and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Safeguard communications and electronics equipment from dust. Remove the dust and debris using approved methods. Removal is to be accomplished daily unless written approval to the contrary is obtained from the RE/COR.
- B. Protection of Buildings From Weather: Contractor shall protect the interior of all structures from weather at all times. Materials and equipment shall be protected from the weather as recommended by the manufacturer.
- C. Protection of Facilities: Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.
- D. Burning: Burning at project sites for the disposal of refuse and debris will not be permitted.
- E. Explosives: The use of explosives and pyrotechnics for demolition is not permitted.

3.3 Disposition of Equipment and Materials:

- A. Title to Materials: Title to items to be re-used including the Teepee, obstruction light, counterpoise plate, the RF Box, RF cable fittings within the RF Box, the monitor detector antennas (MDA's,) the DME antenna, the VOR antenna, the duct between the fan and the RF Box, and all junction boxes shall remain the property of the Government.
- B. Items to be reused shall be indicated on the drawings.

- C. Disposition of Unsalvageable Material: The contractor shall remove all unsalvageable materials and rubble from the work areas. Title to unsalvageable material rests with the Contractor. The unsalvageable materials and rubble removed from the work areas shall be disposed of by the Contractor at an approved off-site location at the Contractor's expense in accordance with all governmental agencies having jurisdiction.

3.4 Cutting and Patching:

- A. Cutting and Drilling: Contractor shall be held responsible at all times for contents and structural conditions of the premises and buildings within the work area. Contractor shall perform or supervise all cutting, drilling, reinforcing, and patching required for work of all the Subcontractors and trades included in the work. Performance and supervision shall be done in a timely manner so as not to hinder the work of other trades. Cutting done by other than the Contractor shall be approved by the FAA. In such cases the Contractor shall supervise such cutting and shall not be relieved of responsibility for error or damage to related or adjoining work, structures, or facilities.
- B. Patching: Cutting of finished surfaces or damage thereto occurring in the course of the work shall be patched and/or repaired to match the existing work in color, texture, alignment, and every other respect to the satisfaction of the FAA. Materials shall be equal to or better than the preconstruction condition.
- C. Repair of Masonry Walls: Openings in masonry walls are not required in this work. Should masonry walls be damaged, the damage shall be repaired by the Contractor including painting and coatings at no additional expense to the Government.

3.5 Quality Assurance:

Contractor shall establish and maintain quality control for the demolition and removal work to assure compliance with the contract requirements. Records shall be maintained for all demolition and removal operations including but not limited to:

- A. Procedures: Safety measures, protection of property and persons, coordination of work, and dust control.
- B. Disposal methods, procedures, and sites.

PART 2 PRODUCTS

This Part Not Used For Demolition or Renovation Work.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

3.1.1 Structures

Remove indicated existing structures to 12 inches below existing foundations.

3.1.2 Utilities and Related Equipment

Remove existing utilities , as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the COR. Remove meters and related equipment and deliver to a location identified by the COR. If utility lines are encountered that are not shown on drawings, contact the COR for further instructions.

3.1.3 Paving and Slabs Not Used

3.1.4 Roofing

If roofing is damaged during the demolition or construction and roof decking is not damaged, remove existing roof system and associated components in their entirety down to existing roof deck. Removal is to be accomplished without damage to the decking, penetrations, or installed equipment. If the decking is damaged, remove and replace the roof including the decking. Sequence work to minimize building exposure between demolition and new roof materials installation. Install temporary roofing and flashing as necessary to maintain a watertight condition throughout the course of the work. Remove temporary work prior to installation of permanent roof system materials unless approved otherwise by the COR. Make provisions for worker safety during demolition and during installation of new materials as described in paragraphs entitled "Statements" and "Regulatory and Safety Requirements." Sequence the work to minimize hazard to workers.

3.1.4.1 Reroofing

When removing the existing roofing system from the roof deck, remove only as much roofing as can be recovered by the end of the work day, unless approved otherwise by the COR. No opening in the roof cover shall be attempted in threatening weather and any opening made shall be resealed prior to suspension of work the same day.

3.1.5 Masonry

Removal of masonry is not part of this contract.

3.1.6 Concrete

Concrete demolition is limited to the removal of 10 pier and footing foundations. Contractor determined methods shall not damage adjacent structures or utilities.

3.1.7 Patching

Where the work leaves holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

- A. Holes and depressions left as a result of removals in existing masonry walls to remain shall be completely filled with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.
- B. Where the work leaves damaged or missing resilient tile flooring, patch to match the existing floor tile.
- C. Patch acoustic lay-in ceiling where partitions have been removed. The transition between the different ceiling heights shall be effected by continuing the higher ceiling level over to the first runner on the lower ceiling and closing the vertical opening with a painted sheet metal strip.

3.1.8 Air Conditioning Equipment – Not Used

Air conditioning equipment is to remain in place. Contractor to protect equipment during all phases of the work.

3.2 FILLING

Fill holes and hazardous openings as indicated and as required to meet pertinent federal, state, and local regulations.

3.3 DISPOSITION OF MATERIAL

3.3.1 Title to Materials

Except where specified in other sections, all materials and equipment removed, and not reused, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the COR of the Contractor's demolition and removal procedures, and authorization by the COR to begin demolition. The Government will not be responsible for the condition or loss of, or damage to, such property after notice to proceed. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

3.3.2 Reuse of Materials and Equipment

Remove and store materials and equipment indicated to be reused or relocated to prevent damage, and reinstall as the work progresses.

3.3.3 Salvaged Materials and Equipment

Remove materials and equipment that are indicated to be removed by the Contractor and that are to remain the property of the Government, and deliver to a storage site as directed.

3.3.4 Disposal of Chlorofluorocarbon Refrigerants

Capture and either dispose of or recycle chlorofluorocarbon refrigerants in accordance with the current amendment of the Clean Air Act.

3.4 CLEANUP

3.4.1 Debris and Rubbish

Remove and transport debris and rubbish in a manner that will prevent spillage on pavements, streets or adjacent areas. Removal, storage, haulage, and disposal of debris and rubbish shall conform to limits imposed by regulations and by structural capacity. If structural elements have adequate capacity, 3/8-cubic yard capacity buggies or other conveyances may be used on roofs and within the building to transport removed debris. The contractor is to determine regulatory and capacity constraints prior to initiating the work. Clean up spillage from pavements, streets and adjacent areas. Conform to other applicable requirements under Sections 01560, 01561, and 02080

END OF SECTION 02050

EARTHWORK – SECTION 02200

PART 1 – GENERAL

1.1 Section Includes: This Section includes the excavation and backfilling requirements for underground utilities and appurtenances as well as access roads, foundations, and parking areas.

1.2 Work Included: The work under this Section includes, but is not limited to the following:

- A. Preparing sub-grades for pads, and foundations.
- C. Sub-base courses for maintenance areas slabs-on-grade, walks, and pavement.
- D. Backfilling for utilities.
- E. Removal of foundations and underground utilities indicated on the construction drawings.
- E. General excavation and fill to include stripping and salvaging top soil, segregating and stockpiling soil, and spreading topsoil.
- F. Excavation required for installation and maintenance for erosion and sediment control.
- G. Protection of Underground Utilities.
- H. Miscellaneous excavation to include fence posts.

1.3 Related Sections:

Section 02220	Installation of Underground Cable
Section 02270	Prevention, Control, and Abatement of Erosion and Water Pollution
FAA-C-1391b	Installation and Splicing of Underground Cables

1.4 Standards and References: The current issues of the following documents in effect on the date of the request for proposal form a part of this specification and are applicable to the extent specified herein.

- A. Unless otherwise indicated on the Construction Drawings or herein specified, all work under this Section shall be performed in accordance with the current Naval Facilities Engineering Command (NAVFAC), Standard Specifications for Roads and Structures.
- B. **American Association of State Highway and Transportation Officials (AASHTO):** T-99– Moisture-Density Relations of Soils Using 5.5 lb (2.5 Kg) Rammer and 12-in. (305 mm) Drop.
- C. **American Society of Testing and Materials (ASTM) Publications:**
ASTM D-1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.

ASTM D-2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

ASTM D-4253 Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table

ASTM D-4254 Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density

D. Natural Resources Conservation Service, (NRCS)

1.5 Definitions: The following terms shall mean the following for this contract:

- A. Excavation:** Consists of the removal of material encountered to subgrade elevations and the reuse or disposal of materials removed.
- B. Sub-grade:** The uppermost surface of an excavation, or the top surface of a fill or backfill, immediately below sub-base, drainage fill, or topsoil materials.
- C. Sub-base Course:** The layer placed between the subgrade and base course in a paving system, or the layer placed between the subgrade and surface of a pavement or walk.
- D. Base Course:** The layer placed between the sub-base and surface pavement in a paving system.

1.6 Submittals: The following items shall be submitted:

- A.** Gradation and compaction reports.
- B.** Name of site-material source and load ticket for each delivery.
- C.** Name of testing firm/lab.
- D.** Vendor data for erosion control materials
- E.** As-Built drawings

PART 2 - PRODUCTS

2.1 Soil Materials:

- A. Sub-base and Base Material:** Naturally or artificially graded mixture of crushed limestone, size gradation of No. 57, 67, or similar locally available approved equal as defined by NAVFAC standards for sub-base course.
- B. Engineered Fill:** Sub-base or base materials.
- C. Foundation Backfill:** Foundation backfill shall be crushed stone, well-graded from coarse to fine, other aggregate, or an approved sand-gravel mixture. No overburden or decomposed and disintegrated rock allowed. The material shall meet the following gradation: 100 percent passing a 1 1/2 inch sieve, 80-100 percent passing a 1 inch sieve and 0-5 percent passing a No. 8 sieve.

- D. Filtering Material:** Evenly graded mixture of natural or crushed gravel or crushed stone and natural sand, with 100 percent passing a 1-1/2 inch sieve and 0 to 5 percent passing a No. 50 sieve.
- E. Earth Fill:** Approved type of soil classified as GW, GP, GM, GC, SW, SP, SM, SC, ML or CL according to the Unified Soil Classification System and free of foreign substances, obtained from excavation for this construction or an approved source and having a plasticity index of 20 or less. Excavated material that meets the requirements for earth fill may be used for filling, backfilling, and grading.
- F. Suitable Material:** Any on-site excavated or borrow material meeting the requirements of “Earth Fill” as defined above shall be considered “Suitable” or “Satisfactory” material for construction of fills, backfills or embankments.
- G. Unsuitable Material:** Any material construction debris containing roots or other organic matter, such as peat, organic silt, or sod, shall be considered unsuitable for use as backfill material or for embankment construction.
- H. Top Soil:** Top layer of soil containing organic material suitable for growing grass and other vegetative materials, free of roots, debris, and other deleterious materials. Topsoil from an off-site location must be from an approved source and have similar characteristics as the on-site topsoil.
- I. Granular Filter:** A transitional layer of gravel placed between the underlying soil and rip rap. Material shall conform to FDOT standards and have an AASHTO gradation of No. 67

2.2 Geosynthetics

Geosynthetic Material: Woven or non-woven plastic fabric used for soil separation as defined in the NAVFAC Standards for their respective use. Geosynthetic material for sediment control shall follow NAVFAC standards unless otherwise directed by the FAA.

PART 3 - EXECUTION

3.1. Demolition of Existing Utilities: Not Required

3.2 Excavation:

- A.** Excavation shall be to the contours and dimensions indicated. Notify the Contracting Officer through the Resident Engineer’s office immediately in writing in the event that it becomes necessary to remove hard, soft, weak, or wet material to a depth greater than indicated, in order for any adjustment in contract price to be considered. Excavations cut below the depths indicated shall, unless otherwise specified, be backfilled with fill or granular fill and be compacted in a manner acceptable to the FAA.
- B. In Case Of An Accident Or Damage To An Existing Utility, The Contractor Shall:**
1. Immediately contact the RE and Airport Emergency Services or facility manager, in case evacuation is required. Follow the Emergency Procedures Plan.

2. Immediately report all damages, including kinking or sheath damage to the FAA. Notify facility owner or operator as directed by the FAA.
- C. Comply with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations.
- D. Preserve, protect and maintain existing operable drains, sewers, and electrical ducts during grading, excavating and backfilling operations. Keep excavations dry. Locations indicated for existing utility facilities are approximate. Pipes or other manmade obstructions, in addition to those indicated, may be encountered. Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Perform all work adjacent to non-Airport utilities as indicated in accordance with procedures outlined by utility owner. Excavation made with power driven equipment is not permitted within five feet of any known existing utility. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered. Support uncovered lines until approval for backfill is granted by the FAA.
- E. Excavation shall be performed so that the area of the site and the area immediately surrounding the site and affecting operations at the site will be continually and effectively drained. Water shall not be permitted to accumulate in the excavation. The excavation shall be drained by pumping or other satisfactory methods to prevent softening of the foundation bottom, undercutting of footings, or other actions detrimental to proper construction procedures. Sediment from dewatering operations shall be controlled prior to off-site release.
- F. Plan for and provide the equipment and construction for the collection and disposal of surface and subsurface water encountered in the course of construction.
- G. Excavation crossing paved areas is not permitted. The width of excavation around existing footings shall extend 1 foot and 6 inches beyond each side of the foundation and six inches below the bottom of the existing concrete footing. All rubble and waste material from this operation shall be completely removed from the site.
- H. Prior to any excavation, all control points established by the Contractor shall be inspected by the FAA.
- H. Existing paved surfaces are not to be removed.
- I. Satisfactory excavated material shall be re-used in the work. No excavated material shall be disposed of in such a manner as to obstruct the flow of any stream, pollute the ocean, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.
- J. When excavations have reached the required elevations, the Contractor shall not proceed with further construction of the excavated area, until the area has been inspected by the FAA.
- K. Excavate footings to required dimension.
1. Excavate to uniform widths to provide a working clearance for formwork.
Excavate trench walls vertically.

2. Clearance: A minimum of 1 foot and 6 inches on all sides.
3. Excavate and shape footing bottoms to provide uniform bearing and support for footings. Shape subgrade to the elevation required to provide continuous support for the sub-base and footings.
- L. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent wind-blown dust. Stockpile soil materials away from edge of excavations. Do not store within drip line of buildings or trees.
- M. **Rock Excavation:** When rock conditions are encountered during excavations for footings or foundations, all material in the excavation area shall be removed to a depth of 6 inches below the bottom of the excavation grade and replaced with suitable material. Over excavation is not required if excavation reveals solid rock at the bottom of the excavation grade and no potentially faulty bearing surfaces, such as soil or crumbling rock, are apparent by visual inspection by the FAA. Rock encountered during footing excavations shall be leveled to a clean, even, hard surface at the indicated grade. No footings shall be permitted to rest partly on soil and partly on rock. In the event that excavation reveals potential foundation bearing surfaces of part rock and part soil, the Contractor shall contact the FAA for resolution of the problem.

3.3 Backfill:

A. General:

1. Prior to backfilling, the owners/operators of existing facilities/utilities that were exposed during potholing or excavation shall be contacted and given the opportunity to inspect for damage that may have occurred during the excavation process. All responses and inspections shall be documented.
2. The Contractor shall take care not to damage existing facilities and utilities during backfill and compaction.
3. All material used to backfill potholed or excavated existing utilities shall be clean and free of large rocks, sharp objects, and large chunks of hard-packed dirt or clay. The requirements for backfill may be found in FAA-C-1391, Installation and Splicing of Underground Cables. The utility owner/operators shall be contacted for additional requirements regarding their utilities.

B. Foundation Backfill

1. Acceptances of construction below finish grade including, where applicable, damp proofing, waterproofing, perimeter insulation and underground utilities are required before backfilling.
2. Backfill excavations promptly after acceptance of construction with Foundation Backfill, but not before completing the following:
 - a. Concrete formwork removal.

- b. Removal of trash, debris, any deleterious materials, and unsuitable soil materials from excavation.

C. Backfill Material:

1. Preparation: Remove vegetation, topsoil, debris, wet, and unsuitable soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.
2. Place fill material in layers to required elevations for each location listed below. Flooding is not permitted.
3. Under footings and foundations, use engineered fill.

D Moisture Control:

- 1 Do not place backfill or fill material on surfaces that are muddy or exceed allowable moisture content.
2. Remove and replace, or scarify and air-dry suitable soil material that is too wet to compact to specified density.
3. Stockpile or spread and dry removed wet suitable soil material.

E. Compaction:

1. Place backfill and fill materials in layers not more than 4 inches in loose depth for material compacted by hand-operated tampers.
2. Place backfill and fill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure.
3. Percentage of Maximum Dry Density Requirements: Compact soil to not less than the following percentages of maximum dry density according to ASTM D-1557.
 - a. Under existing building foundation compact the top 12 inches below subgrade and each layer of backfill or fill material to 95 percent maximum dry density.
 - b. Compact earth fill and cohesive aggregate fill to a minimum of 95% of maximum dry density as determined by ASTM D-1557, Standard Proctor by using nuclear methods.
 - c. Compact cohesionless aggregate fill on which it is not practical to control the density by "Proctor" methods to a minimum of 75% of relative density as determined by ASTM D-4253 and D-4254, by a field compaction mold method correlated to ASTM D-4253 and D-4254. Compact cohesionless aggregate fill at a moisture content within a range that accommodates consistent placement and compaction to the minimum relative density specified above.

F. Grading:

1. General:

- a. Provide a smooth transition between existing adjacent grades and backfill placed around new footings. Uniformly grade areas to a smooth surface free from irregular surface changes. Comply with compaction requirements and grade to slope water away from the footings and the site.
- b. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.

2. Site Grading

Slope grades to direct water away from structures and to prevent ponding.
Finish subgrades to required elevations within a 1 inch tolerance.

F. Sub-base and Base Courses:

1. Grade, shape, and compact sub-base and base courses to grades, lines, cross sections and thickness to not less than shown on the Construction Drawings.
2. When thickness of compacted sub-base or base course is 6 inches or less, place materials in two equal layers. Compact each layer.
3. When thickness of compacted sub-base or base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

H. Drainage Fill: Not Used

I. Field Quality Control:

1. General: Contractor will employ a testing laboratory to perform tests and to submit test reports. Alternatively, Contractor may perform the testing. Sampling and testing for quality control during placement of fill, base, and/or subgrade shall include the following:
 - a. Testing Agency Services: Allow testing agency to inspect and test each subgrade, subbase, and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements. Unless otherwise specified in the plans or these specifications, all testing shall be in accordance with Florida Department of Transportation standard procedures.
 - b. Footing Subgrade: At footing subgrades, perform at least one test of each soil stratum to verify design-bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of each subgrade with related tested strata when acceptable to the FAA.
 - d. Below Specified Density: When testing agency reports that subbase or bases are below specified density, moisten, aerate, or remove and replace backfill material to the depth required, re-compact and retest until required density is obtained, at no additional cost to the government.

2. When Contractor performs the tests, an independent third party firm shall be employed by the contractor to certify all test results.

J. Disposal of Surplus and Waste Materials

1. Disposal: Transport surplus suitable soil to designated storage areas on the Airport's property. Stockpile or spread soil as directed by FAA. Protect stockpiles from erosion. Stabilize stockpiled material as directed by the FAA.
2. Removal: Remove waste material, including unsuitable soil, trash, and debris, and legally dispose of it off the Airport's property.
3. Burning: No burning of materials shall be permitted on the site.

END OF SECTION 02200

PREVENTION, CONTROL AND ABATEMENT OF EROSION AND WATER POLLUTION

PART 1 – GENERAL

1.1 Work Included: The work covered by this Section shall consist of the Best Management Practices (BMPs) for furnishing, installing, maintaining and removing temporary erosion control devices on the Project and in areas outside the construction limits where work is accomplished in conjunction with the project, so as to prevent pollution of water, air, detrimental effects to public or private property adjacent to the project limits, and damage to work on the project. Where practical, temporary erosion control features shall be constructed and maintained as outlined within the Contractor's approved Erosion Control Plan. Stabilized construction exits are a mandatory BMP on this project.

1.2 Related Sections: Section 02200 Earthwork

1.3 Standards and References:

A. The American Society for Testing and Materials (ASTM) Publications: Publications listed in Sections 02200 form a part of this specification to the extent referenced.

B. Naval Facilities Engineering Command

1.4 Submittals:

A. Erosion Control Plan:

1. General overall Erosion and Sediment Control Plan: An Erosion and Sedimentation Control Plan (ESCP) shall be prepared for this project and be included as a submittal to the FAA for review and approval prior to the start of demolition. The ESCP shall be the minimum effort necessary to prevent soil erosion and minimize off-site sedimentation. The Contractor may implement an alternative plan provided that said Plan is first approved by the FAA prior to implementation and commencement of earth disturbing activities of this project. The plan submitted shall depict the BMPs for the erosion control measures, and be submitted within 5 days after NOA. The proposed plans for installation of erosion and sediment control devices shall include a schedule of construction activities, which shall be based on project conditions and shall be in written form. This schedule shall specifically indicate the sequence of earthwork operations and the proposed use of temporary erosion and sediment control features. This plan shall also outline the Contractor's proposed methods of controlling erosion and sedimentation of haul roads and areas used for waste materials from the project. This submission shall include but is not limited to the following:
2. Detailed breakdown of BMPs (erosion and sediment control devices) as required for different stages of construction;
3. Set of marked plans or detailed drawings showing areas of control devices and purpose for each;

4. Subsequent staging plans and specific site plans may be submitted to the FAA for approval as the work progresses. These plans shall be submitted a minimum of two (2) weeks in advance of construction, to allow review by the FAA. No work shall be started until the FAA has accepted the aforementioned plans. The Contractor will be responsible for accomplishment of the work in accordance with the approved plans. The FAA may have changes approved that are necessary due to unforeseen circumstances that are beyond the control of the Contractor.

B. Plan Contents:

- a. Overview of Erosion and Sedimentation Control Plan: The plan shall consider, but is not limited to the following:
 1. General Requirements
 2. Contractor Submittal
 - a). Contractor must review and sign the Erosion and Sedimentation Control Plan
 - b). Contractor must make commitment to provide erosion and sediment control as specified in the Erosion and Sedimentation Control Plan and as directed by the FAA
 3. No earth disturbing activities shall commence until acceptance by FAA
- b. Erosion Control Schedule
 1. General Overall Erosion and Sedimentation Implementation Plan (Narrative)
 2. Breakdown of Erosion and Sediment Control Devices (Summary of Quantities)
 3. Marked Plans or Detailed drawing showing Control Devices and Purposes
 4. Site and Staging Plans
- c. Plan Considerations
 1. Terrain: hilly, flat, continuous slope
 2. Drainage Area
 3. Soil Conditions: Clay, sandy, rock
 4. Narrative
 - a). Worksite Erosion Control Supervisor (WECS) identified and listing of relevant qualifications
 - b). Summary of quantities for erosion control devices
 - c). Grassing
 5. Plans
 - a). Proximity of drainage ditches, canals, and other storm water conveyance facilities
 - b). Locations of Construction Exit onto Access/Paved Roadways
 - c). Location of Silt Fence and/or Gates
 - d). Type of Silt Fence.

PART 2 – PRODUCTS

2.1. Best Management Practices: BMP practices may include, and are not limited to:

- a. Construction Exit
- b. Silt Fence – Reinforced
- c. Other barriers

PART 3 - EXECUTION

3.1 Scheduling of Successive Operations: Operations shall be scheduled such that the area of unprotected erodible earth exposed at any one time is not larger than the minimum area necessary for efficient construction operations and that the duration of exposure of uncompleted construction to the elements is minimized.

3.2 Construction Requirements:

A. General: The FAA has the authority to limit the surface area of erodible earth material exposed by trenching and excavation, and to direct the Contractor to provide immediate permanent and/or temporary erosion control measures to prevent contamination of adjacent drainage ditches, canals, the ocean, or other areas of water impoundment. Such work should coincide with the Contractor's Erosion Control Plan. Cut slopes shall be stabilized as the excavation proceeds. Under no circumstances shall grading be allowed to exceed the operating range of the stabilization operation. In addition to minimizing erosion, this is necessary to keep attraction to birds, to a minimum. The Contractor shall incorporate all erosion control features into the Project at the earliest practicable time as outlined in his accepted Plan.

B. Erodible Area: The Contractor shall limit the area of excavation and trenching operations commensurate with the Contractor's capability and progress in keeping the erosion control measures current in accordance with the accepted Plan. . In no instance shall any disturbed area or stockpile be left exposed beyond the current work day. All disturbed areas and stockpiles shall be temporarily stabilized with sod, mulch, or non-erosive granular materials at the end of each work day.

C. Maintenance: All temporary erosion and sediment control measures shall be maintained throughout the duration of the project until final acceptance, or final stabilization of upstream tributary areas. Measures shall only be removed upon approval by the FAA. Silt Fence shall be repaired or replaced at the presence of tears, holes or bulges in the fabric, and shall be re-staked as necessary to maintain compliance with the lines identified in the Erosion and Sediment Control Plan.

3.3 Protection During Suspension of Contract Time - In the event that it is necessary to suspend the construction operations for any appreciable length of time, the top of the earthwork shall be shaped in such a manner as to permit runoff of rainwater. The FAA has the authority to require the application of temporary sodding and other erosion and sediment control measures to minimize erosion and sediment transport.

END OF SECTION

CONCRETE

PART 1 - GENERAL

1.1 Scope: This Section specifies cast-in-place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.

1.2 Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified.

1. ACI 318, "Building Code Requirements for Reinforced Concrete".
2. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice".

1.3 Submittals - Submit mix design for all classes of concrete, and all laboratory or field tests performed in accordance with Paragraph 3.14.

PART 2 - PRODUCTS

2.1 Form Materials

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in large practicable sizes to minimize number of joints and to conform to joint system shown on the drawings.

B. Forms for Unexposed Finish Concrete: Provide plywood, lumber, metal, or other acceptable material. Lumber shall be dressed on at least two edges and one side for tight fit.

2.2 Plywood Forms: Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, exterior grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

2.3 Forms Coatings: Provide commercial form coating that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.4 Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units that will leave no metal closer than 3 inches to exposed surface. Provide ties that, when removed, will leave holes not larger than #3 tie wire or 0.375 inches diameter in concrete surface.

2.5 Reinforcing Materials

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed, except A307 for bars to be welded. Detailed and fabricated in accordance with ACI 315.

B. Welded Wire Fabric: ASTM A 185, welded steel wire fabric.

C. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire-bar-type supports complying with CRSI specifications.

1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

2.6 Concrete Materials

A. Portland Cement: ASTM C 150, Type I. Use one brand of cement throughout project.

B. Fly Ash: ASTM C 618, Type C or Type F.

C. Normal Weight Aggregates: ASTM C33 and as herein specified. Provide aggregates from a single source for exposed concrete.

1. Do not use fine or coarse aggregates containing deleterious substances that cause spalling.
2. Local aggregates not complying with ASTM C33 but that special tests or actual service have shown to produce concrete of adequate strength and durability may be used when acceptable to materials certification entity.

D. Water: Potable.

E. Admixture, General: Provide admixtures for concrete that contain not more than 0.1 percent chloride ions.

1. Air-Entraining Admixtures - ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
2. Water Reducing Admixture - ASTM C 494, Type A.
3. High-Range Water-Reducing Admixture (Superplasticizer) - ASTM C 494, Type F or Type G.
4. Water-Reducing, Accelerating Admixture - ASTM C 494, Type E.
5. Water-Reducing, Retarding Admixture - ASTM C 494, Type D.

2.7 Related Materials

- A. Vapor Retarder:** Use only materials that are resistant to deterioration when tested in accordance with ASTM E 154, as follows: Polyethylene sheet - not less than 8 mils thick.
- B. Absorptive Cover:** Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
- C. Moisture-Retaining Cover:** - One of the following, complying with ASTM C 171.
 - a. Waterproof paper.
 - b. Polyethylene film.
 - c. Polyethylene-coated burlap.
- D. Liquid Membrane-Forming Curing Compound:** Liquid-type membrane-forming curing compound complying with ASTM C 309, Type I, Class A. Moisture loss not more than 0.055 gr./sq.cm. when applied at 200 sq.ft./gal.
- E. Evaporation Control:** Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.

PART 3 - EXECUTION

3.1 General: Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

3.2 Forms

- A. General:** Design, erect, support, brace, and maintain formwork to support vertical and lateral, static and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with ACI 347. Construct forms to sizes, shapes, lines and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, molding, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.
- B. Fabrication:** Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

- C. Temporary Openings:** Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- D. Chamfer:** Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- E. Provisions for Other Trades:** Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
- F. Cleaning and Tightening:** Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retighten forms and bracing before concrete placement as required to prevent mortar leaks and maintain proper alignment.

3.3 Vapor Retarder/Barrier Installation

- A.** Following leveling and tamping of base for slabs on grade, place vapor retarder/barrier sheeting with longest dimension parallel with direction of pour.
- B.** Lap joints 6 inches and seal vapor barrier joints with manufacturer's *recommended mastic* and pressure-sensitive tape.
- C.** After placement of vapor retarder/barrier, cover with sand cushion and compact to depth as shown on drawings.

3.4 Placement of Reinforcement

- A.** Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcement Bars," for details and methods of reinforcement placement and supports and as herein specified.
- B.** Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations.
- C.** Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
- D.** Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by RE .

- E. Place reinforcement to obtain at least minimum coverage or as shown on the drawings whichever is greater for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Set wire ties so ends are directed into concrete, not towards exposed concrete surfaces. Lap distance shall be in accordance with ACI 315. Minimum lap of a bar is 24 times bar diameter.
- F. Install welded wire fabric in lengths as long as practical. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous line of lap in either direction.

3.5 Preparation of Form Surfaces

- A. Coat contact surfaces of forms with an approved, non-residual, low-VOC, form-coating compound before reinforcement is placed.
- B. Do not allow excess form-coating material to accumulate in forms or to come into contact with in place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

3.6 Proportioning and Design of Mixes

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 211.1 and batched in accordance with ACI 304.
- B. Limit use of fly ash to not exceed 25 percent of cement content by weight. Fly ash is not to be used where high early strength is specified.
- C. Contractor shall design mixes to provide normal weight concrete with the following properties, or as indicated on drawings and schedules: 3000-psi, 28-day compressive strength; W/C ratio, 0.58 maximum (non-air-entrained), 0.46 maximum (air-entrained.) Course aggregate may be any one of the following sizes: No. 57, No. 6, No. 67, or No. 8. When No. 8 size is used, the entrained air content shall be 8 +/- 2 percent. Otherwise, the entrained air shall be 6 +/- 2 percent. The RE's approval of the concrete mix design will be based on the Contractor's submitted proportions and the foregoing information.
- D. Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by FAA. Laboratory test data for revised mix design and strength results must be submitted to and accepted by RE before using.

E. Admixtures

1. Use water-reducing admixture or high-range water-reducing admixture (Superplasticizer) in concrete as required for placement and workability.
2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F (10 deg C).

3. Use high-range water-reducing admixture (HRWR) in pumped concrete, architectural concrete, concrete required to be watertight, and concrete with water/cement ratios below 0.50.
4. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent within following limits:
 - a. Concrete structures and slabs exposed to freezing and thawing - 4.5 percent (moderate exposure) 1-1/2-inch max. aggregate.
 - b. Other concrete (not exposed to freezing, thawing, or hydraulic pressure) or to receive a surface hardener: 2 percent to 4 percent air.
5. Use admixtures for water reduction and set control in strict compliance with manufacturer's directions.

F. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Ramps, Slabs, and Sloping Surfaces - Not more than 3-inches.
2. Reinforced Foundation Systems - Not less than 1-inch and not more than 3- inches.
3. Concrete Containing HRWR Admixture (Superplasticizer) - Not more than 8 inches after addition to HRWR to site-verified 2-inch to 3-inch slump concrete.
4. Other Concrete - Not more than 4-inches.

3.7 Ready-Mix concrete

- A.** Ready-Mix Concrete shall comply with requirements of ASTM C 94, and as specified.
- B.** Provide to the RE a batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.
- C.** When air temperature is between 85 deg. F (30 deg. C) and 90 deg. F (32 deg. C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg. F (32 deg. C), reduce mixing and delivery time to 60 minutes.

3.8 Concrete Placement

- A. General:** Comply with ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete," and as herein specified.
- B. Inspection:** Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work.
- C. Placing Concrete in Forms:** Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete to avoid segregation at its final location.
1. Consolidate placed concrete primarily by mechanical vibrating equipment, supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6-inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
- D. Placing Concrete Slabs:** Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. The use of added water or other medium to increase surface water in conjunction with use of a float or darbie is not permitted. Do not disturb slab surfaces prior to beginning finishing operations.
 3. Maintain reinforcing in proper position during concrete placement.
- E. Cold-Weather Placing:** Comply with provisions of ACI 306 and as follows.
1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 2. When air temperature has fallen to or is expected to fall below 40 deg. f (4 deg. C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg. F (10 deg. C) and not more than 80 deg. F (27 deg. C) at point of placement.

3. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
4. Do not use calcium chloride salt, and other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

F. Hot-Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 Deg. f (32 deg. C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
3. Fog-spray forms, reinforcing steel, and subgrade just before concrete is placed.
4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions.

3.9 Finish of Formed Surfaces

- A. Rough Form Finish:** For formed concrete surfaces not exposed to view in the finish work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4-inch in height rubbed down or chipped off.
- B. Smooth Form Finish:** For formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, such as waterproofing, damp-proofing, veneer plaster, painting, or other similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.
- C. Related Unformed Finish:** At tops of walls, horizontal offsets, and similar unformed surfaces **OCCURRING** adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 Monolithic Slab Finishes

A. Scratch Finish: - Not Applicable

B. Trowel Finish: The inner face of the forms is intended to produce a smooth, blemish free surface. Apply trowel finish to monolithic slab surfaces to be exposed to view and surface defects are visible. After floating, begin first trowel finish operation. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surfaces leveled and uniform.

3.11 Concrete Curing And Protection

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material.

B. Initial Curing: Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Keep continuously moist for not less than 7 days.

C. Curing Methods: Perform curing of concrete by moist curing, or by moisture-retaining cover curing, or by curing and sealing compound, or by combinations thereof, as herein specified.

1. Moist Curing

- a. Keep concrete surface continuously wet by covering with water; or
- b. Use continuous water-fog spray; or
- c. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers.

2. Moisture-Retaining Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practical width with sides and ends lapped at least 3-inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during period using cover material and waterproof tape.

D. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

E. Curing Unformed Surfaces: Not used.

F. Treated Surfaces: Not used

3.12 Removal of Forms: Formwork may be removed after cumulatively curing at not less than 50 deg. F (10 deg. C) for 72 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

3.13 Concrete Surface Repairs

- A. Repair and patch defective areas with cement mortar immediately after removal of forms.
- B. Cut out honeycomb, rock pockets, voids over 1/8-inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of less than 1-inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar before bonding compound has dried.
- C. **For Exposed-to-View Surfaces:** Blend white Portland cement and standard Portland cement so That, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- D. **Repair of Formed Surfaces:** Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of RE. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface, and stains and other discoloration's that cannot be removed by cleaning. Flush out form tie holes, fill with dry-pack mortar.
1. Concealed Formed Surfaces: Where possible, repair defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
 2. RE will determine if repairs are acceptable.
- E. **Repair of Unformed Surfaces: Not Used – All surfaces are formed**

3.14 Quality Control Testing During Construction

- A. **General:** The Contractor will either employ a testing laboratory or perform testing in-house and to submit test reports. All testing must be certified by a third-party independent company properly licensed to provide such certifications. Sampling and testing for quality control during placement of concrete shall include the following:
- B. **Sampling Fresh Concrete:** ASTM C 172, except modified slump to comply with ASTM C 94.
1. Slump: ASTM C 143; one test at point of discharge for each day's placement of each type of concrete; additional tests when RE determines that concrete consistency appears to have changed.

2. Air Content - One for each day's placement of each type of air-entrained concrete (ASTM C 173, volumetric method for light weight concrete; ASTM C 231 pressure method for normal weight concrete).
3. Concrete Temperature: Test hourly when air temperature is 40 deg. F (4 deg. C) and below, when 80 deg. F (27 deg. C) and above, and each time a set of compression test specimens is made.
4. Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
5. Compression Strength Tests: ASTM C 39; one set for each day's placement not exceeding 5 CY, plus additional sets for each 50 CY more than the first 25 CY of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

C. Test Results: Test results will be reported in writing to RE, Ready-Mix Producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.

D. Standards: Strength level of concrete will be considered satisfactory if averages of sets of three consecutive 28-day strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.

1. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
2. If both field tests and laboratory tests fail, additional tests are required. Replacement of the failing concrete may be required if required by the RE.

E. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by RE. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests when unacceptable concrete is verified.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL & ALUMINUM

PART 1 - GENERAL

1.1 Work Included: Furnish, fabricate, and erect structural steel, aluminum, and other items as shown on the drawings or required by other divisions of these specifications. Provide inspector to inspect bolts and welds during steel erection and welding and installation of aluminum counterpoise.

1.2 Applicable Publications: Industry publications controlling the work of this division include:

A. American Institute of Steel Construction (AISC): Manual of Steel Construction, Allowable Stress Design (ASD).

B. American Society for Testing and Materials (ASTM):

ASTM A36-90 Structural Steel.

ASTM A53-90a Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless.

ASTM A108-90a Steel Bars, Carbon, Cold Finished, Standard Quality.

ASTM A123-89a Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

ASTM A307-90 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

ASTM A325-90 High-Strength Bolts for Structural Steel Joints.

ASTM A490-90 Heat-Treated, Structural Steel Bolts, 150 (KSI) (1035MPa) Tensile Strength.

ASTM A500-90 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

ASTM A563-90 Carbon and Alloy Steel Nuts.

ASTM B209 Aluminum and Aluminum-Alloy Sheet and Plate

ASTM A780-80 Standard Practice for Repair of Damaged Hot-Dip Galvanized Coatings.

ASTM B695-91 Coatings of Zinc Mechanically Deposited on Iron and Steel.

ASTM F436-90 Hardened Steel Washers.

ASTM F959-90 Compressible-Washer-Type Direct Tension Indicator for Use with Structural Fasteners.

C. American Welding Society (AWS):

AWS A5.1: Covered Carbon Steel Arc Welding Electrodes¹.

AWS A5.5: Low Alloy Steel Covered Arc Welding Electrodes.

AWS C2.2-67: Recommended Practices for Metalizing with Aluminum and Zinc for Protection of Iron and Steel.

AWS D1.1: Structural Welding Code - Steel.

AWS D1.2: Structural Welding Code - Aluminum

D. Research Council on Structural Connections (RCSC):

"Specifications for Structural Joints Using ASTM A325 Bolts or ASTM A490 Bolts," as endorsed by AISC.

E. Steel Structures Painting Council (SSPC):

SSPC-SP3: Power Tool Cleaning.

SSPC-Paint 11: Red Iron Oxide, Zinc Chromate, Raw Linseed Oil and Alkyd Paint.

1.3 Submittals: Submit Fabrication and erection drawings showing all details, connections, material designations, and all top of steel elevations.

1.4 Quality Assurance: Welders shall be qualified as prescribed in AWS D1.1 and AWS-D1.2

PART 2 - PRODUCTS

2.1 Structural Steel - Structural shapes, plates, bars, tubing and steel pipe shall conform to the following specifications:

A. Shapes, plates and bars: conform to ASTM A36.

B. Structural tubing: conform to ASTM A500, Grade B.

C. Steel pipe: conform to ASTM A53, Type E or S, Grade B.

2.2 Anchor Bolts: conform to ASTM A307 with heavy hexagonal nuts.

2.3 Bolts: Bolts shall be in accordance with the following:

A. Common (machine) bolts shall conform to ASTM A307 Grade A and nuts to ASTM A563. One common bolt assembly shall consist of a bolt, a heavy hex nut, a lock nut and a hardened washer.

- B.** High strength bolts shall conform to ASTM A325. One high strength bolt assembly shall consist of a heavy hex head structural bolt, a heavy hex nut, a hardened washer conforming with ASTM F436 and a direct tension indicator conforming with ASTM F959. The hardened washer shall be installed against the element turned in tightening.

2.4 Welding Electrodes:

- A.** When welding steel, welding electrodes shall comply with AWS D1.1 using AWS A5.1 or AWS A5.5 E70XX and shall be compatible with the welding process selected.
- B.** When welding aluminum follow the requirements of AWS 1.2.

2.5 Headed Welded Studs: Not Used

2.6 Locknut: For use with other than high strength bolts.

- A. Alternate 1:** “Palnuts” as manufactured by Palnut Company of Irvington, NJ, or approved equal.
- B. Alternate 2:** “Anco Lock Nut” as manufactured by Automatic Nut Co. of Lebanon, PA, or approved equal, in lieu of the regular hex nut and the locknut.

2.7 Primer: Primer shall be a red oxide-chromate primer complying with SSPC Paint Specification No. 11.

2.8 Aluminum Plate

- A.** Use welding of the inert gas, shield-arc type. For procedures, appearance and quality of welds and the methods used in correcting welding work, conform to AWS D1.2.
- B.** Mechanical Fastening of Aluminum
- C.** Aluminum surfaces shall not directly contact other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer followed by two coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint.

PART 3 - EXECUTION

3.1 Fabrication: Shop fabricate and assemble materials as specified herein.

- 3.1.1** Fabricate items of structural steel in accordance with the AISC-ASD Specifications, and as indicated on the approved shop drawings.
- 3.1.2** Properly mark and match-mark materials for field assembly and for identification as to location for which intended.

3.1.3 Fabricate and deliver in a sequence which will expedite erection and minimize field handling of materials.

3.1.4 Where finishing is required, complete the assembly, including welding of units, before start of finishing operations.

3.1.5 Provide finish surfaces of members exposed in the final structure free from markings, burrs, and other defects.

3.1.6 Provide connections as specified herein.

3.1.6.1 Provide bolts and washers of types and sizes required for completion of field erection.

3.1.6.2 Install high strength threaded fasteners in accordance with RCSC "Specifications for Structural Joints Using ASTM A325 or ASTM A490 Bolts."

3.1.6.3 Welded construction for steel shall comply with AWS D1.1 for procedures, appearance, quality of welds, and methods used in correcting welded work.

3.1.6.4 Welded construction for aluminum shall comply with AWS D1.2 for procedures, appearance, quality of welds, and methods used in correcting welded work.

3.1.6.5 Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

3.1.6.6 All connections which are not detailed or otherwise noted on the design drawings shall be shop welded and field bolted in accordance with AISC Framed Beam Connections, Tables II and III as shown in the AISC-ASD Manual of Steel Construction. Use the maximum number (n) rows of field bolts compatible with a beam T dimension and flange cope for each beam depth under consideration. Use a 1/4-inch shop weld "A" shown in Table III for the required number of field bolts. All bolted connections shall be designed for the full capacity of the connecting members.

3.1.6.7 The fabricator shall furnish and install erection clips for fit-up of welded connections.

3.1.6.8 Double angle members shall have welded fillers spaced in accordance with Chapter E4 of the AISC-ASD Specification.

3.2 Plates: Gusset and stiffener plates shall be 3/8-inch thick minimum.

3.3 Columns: Columns shall have full bearing at splices and at end plates.

3.4 Camber: All members shall be fabricated with natural camber up.

3.5 Shop Priming: Structural steel shall be shop primed as specified herein, unless shown otherwise on the drawings.

3.5.1 Structural steel surface preparation shall conform to SSPC-SP3, "Power Tool Cleaning."

3.5.2 Surface preparation and primer application shall be in accordance with AISC Code of Standard Practice as included in the ASD Manual of Steel Construction.

3.5.3 Storing, thinning, mixing, handling, and application of paint materials shall be in accordance with manufacturer's instructions. Containers shall remain closed until required for use. Manufacturer's pot-life requirements shall be strictly adhered to.

3.5.4 Primer shall be applied to dry, clean, prepared surfaces and under favorable conditions in accordance with manufacturer's instructions. Unless otherwise recommended by manufacturer, priming shall not be done when the ambient temperature is less than 50°F, the relative humidity is more than 90 percent, or the surface temperature is less than 5°F above the dew point.

3.5.5 Generally, all primer shall be spray applied. Brush or roller application shall be restricted to touch-up and to areas not accessible by spray gun.

3.5.6 Primer shall be uniformly applied without runs, sags, solvent blisters, dry spray or other blemishes. All blemishes and other irregularities shall be repaired or removed and the area recoated. Special attention shall be paid to crevices, weld lines, bolt heads, corners, edges, etc., to obtain the required nominal film thickness.

3.5.7 The dry film thickness of the primer shall be 2.0 mils.

3.5.8 If primer is damaged by welding or physical abuse, the area shall be touched-up and repaired. The touch-up paint shall be compatible with the applied primer with minimum dry film thickness of 1.5 mils.

3.5.9 All primers and touch-up paint shall be applied in strict accordance with the manufacturer's instructions and these specifications.

3.6 Galvanizing: All galvanizing shall be as specified herein.

3.6.1 When indicated on the drawings, structural steel including ladder, checkered plate, bolts, nuts and washers shall be galvanized in accordance with this Section and the applicable ASTM Standards.

3.6.2 Galvanizing of structural steel shapes, plates, bars and strips shall be in accordance with ASTM A123. Minimum weight of zinc coating shall be 2.0 oz/ft² for individual specimen and minimum thickness of 3.4 mils.

3.6.3 When specified on drawings, all bolts, nuts and washers shall be mechanically zinc coated in accordance with ASTM B695, Type I. Nuts shall be tapped oversize in accordance with ASTM A563 prior to zinc coating and need not be re-tapped after coating.

3.6.4 The fabricator shall be responsible to safeguard against embrittlement and warpage.

3.6.5 Whenever practical, cutting, drilling and welding shall be performed prior to galvanizing.

3.7 Erection: Erection of structural steel shall be as specified herein.

3.7.1 Erection of structural steel shall comply with AISC "Code of Standard Practice."

3.7.2 Structural field welding shall be done by the electric submerged or shielded metal arc process. Welded construction shall comply with AWS D1.1.

3.7.3 Headed welded studs are not used.

3.7.4 Provide anchor bolts and other connectors required for securing structural steel to foundations and other in-place work. Provide templates and other devices necessary for presetting bolts and anchors to accurate locations.

3.7.5 Splice members only where indicated on the drawings.

3.7.6 Gas cutting torches shall not be used for correcting fabricating errors in the structural framing. Gas cutting is permitted only in secondary members. Finish gas cut sections to a sheared appearance.

3.7.8 Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Provide temporary guy lines to achieve proper alignments of the structure as erection proceeds. Remove temporary connections and members when permanent members are in place and the final connections have been made.

3.7.9 Provide and set bases and bearing plates as specified herein. Clean concrete bearing surfaces free from bond-reducing materials, and then roughen to improve bond to the surface. Clean the bottom surface of base and bearing plates. Set loose and attached base plates and bearing plates for structural members in wedges or other adjusting devices. Tighten anchor bolts after the supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with the edge of the base or bearing plate prior to packing with grout. Grout solidly between bearing surfaces and bases or plates to assure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure in strict compliance with the manufacturer's recommendations.

3.7.10 Set structural frames accurately to the lines and elevations indicated.

3.7.11 Align and adjust members forming part of a complete frame or structure before fastening permanently.

3.7.12 Clean bearing surfaces, and other surfaces which will be in permanent contact, before assembly.

3.7.13 Level and plumb individual members of the structure within AISC tolerances in accordance with the AISC Code of Standard Practice as included in the ASD Manual of Steel Construction.

3.7.14 Establish required leveling and plumbing measurements on the mean operating temperature of the structure, making allowances for the difference between temperature at time of erection and the mean temperature at which the structure will be when completed and in service.

3.7.16 Install and fully tension high strength threaded fasteners in accordance with RCSC, "Specifications for Structural Joints Using ASTM A325 or ASTM A490 Bolts."

3.8 Repairing Damaged Hot-Dip Galvanized Coatings: When approved by the RE, hot-dip galvanized coatings shall be repaired as follows:

3.8.1 All damaged hot-dip galvanized coatings of reamed or field-drilled holes shall be repaired using a zinc-rich paint.

3.8.1.1 As a minimum, the zinc-rich paint dried film shall contain 94% zinc dust by weight, and shall conform to ASTM A780-80.

3.8.1.2 Minimum dry film thickness is 3 mils.

3.8.1.3 Acceptable products include Z.R.C. liquid cold galvanizing compound with shiny finish, by ZRC Products Company, or previously approved alternate.

3.8.2 All other damaged galvanized coatings shall be repaired using a metalizing/thermal spray coating process per AWS C2.2-67.

3.8.2.1 Use a metalizing alloy composed of 85% zinc and 15% aluminum.

3.8.2.2 Minimum coat thickness shall be 6 mils. Dry film thickness shall be measured by using a magnetic or electromagnetic gage. Measurements shall be taken in the presence of the RE Designee at locations selected by the RE.

3.8.3 Surface Preparation:

3.8.3.1 Surfaces to be reconditioned shall be clean, dry, and free of oil, grease, and corrosive products.

3.8.3.2 Surface preparation shall be in accordance with ASTM A870 and AWS C2.2-67.

3.8.3.3 To ensure a smooth coating, surface preparation shall extend into the undamaged galvanized coating. The method and extent of surface preparation shall be approved by the RE.

END OF SECTION

STRUCTURAL STEEL ERECTION

SECTION 05121

PART 1 - GENERAL

1.1 Work Included: Furnish all labor and materials, equipment and incidentals necessary to erect structural steel and miscellaneous metals.

1.2 Related Work Covered Elsewhere:

Cast-in-Place Concrete Section 03301

Structural Steel Section 05120

Miscellaneous Metals Section 05500

Painting Section 09900

1.3 QUALITY ASSURANCE:

A. Testing:

1. All shop welds shall be visually inspected and physically tested. Full penetration shop and field welds shall be non-destructive tested by radiographic, ultrasonic, magnetic particle or dye penetrant methods in accordance with AWS B1.10 as approved by the Contracting Officer. Tubular constructions shall be inspected by ultrasonic methods, Class R. All test methods and procedures used shall be determined and approved by the RE in advance of welding.
2. Welding shall be inspected and certified by an independent, third-party testing agency selected by the Contractor. The testing agency is the representative of the Government and the Contractor shall make all facilities available for inspection at all times, including Shop Fabrication. Inspection of welding shall be in conformance with AWS D1.1 "Structural Welding Code Steel".
3. High Strength Bolts in connections shall be inspected by independent, third-party testing agency in accordance with AISC "Specification for Structural Joints using ASTM A-325 or A-490 Bolts". Records shall be kept for all testing and shall show date of inspection, location and type of and size of bolts tested, defects encountered, and date of replacement.

B. Re-inspection: Contractor shall bear costs of re-inspection due to specification non-conformance discovered during tests.

C. Welder's Qualification:

1. Steel Welds shall be made only by operators who have previously qualified by tests, as prescribed by the "Standard Qualification Procedure" in the "Structural Welding Code - " by the American Welding Society to perform the type of work required. The contractor shall provide certification that welders have passed qualification test within six months just prior to performance of work.
2. The techniques of welding employed, the appearance and quality of welds made, and methods used in correcting defective work shall conform to Section 4, "Technique" of the Current Edition of the "Structural Welding Code - Steel" by the American Welding Society.
3. Aluminum Welds shall be made only by operators who have previously qualified by tests, as prescribed by the Code – AWS D1.2 Structural Welding Code - Aluminum to perform the type of work required. The contractor shall provide certification that welders have passed qualification test within six months just prior to performance of work.

1.4 Submittals:

Submittals shall be in accordance with general requirements and shall include the following:

- A.** Certificate of Welder's qualification
- B.** Schedule of Time Schedule for Shop fabrication
- C.** Erection Schedule and Description of Erection Procedures
- D.** Setting Bolt and Anchor Plate Templates.

1.5 References and Standards:

The applicable provisions of the following references and standards are hereby made a part of this Section as if written herein in their entirety:

- A. American Institute of Steel Construction (AISC) Publications:** "Specifications for Structural Steel Buildings"
- B. Steel Joist Institute (SJI): Not Used**
- C. American Welding Society (AWS) Publication:** "Code for Arc and Gas Welding in Building Construction"

AWS D1.1 Structural Welding Code – Steel

AWS D1.2 Structural Welding Code – Aluminum

AWS B1.10 Guide for Non-Destructive Inspection of Welds

AWS A5.1 Specification for Covered Carbon Steel Arc Welding Electrodes

AWS A5.5 Specification for Low Alloy Steel Covered Arc Welding Electrodes

D. Military Specification: MIL-P-21035, High Zinc Dust Content, Galvanizing Repair.

1.6 Delivery, Handling, and Storage:

Deliver steel members and fabricated components to site and store on wood runners or platform raised above grade level. Steel shall not come into contact with groundwater.

1.7 Job Conditions:

- A.** Erection of steel shall be in proper sequence with the work of other trades. Steel shall be erected in a reasonable sequence and shall be guyed and braced as erected.
- B.** Obtain complete field dimension prior to fabrication of steel. Re-check dimensions as steel is erected. Report deficiencies or errors to the contracting officer through the resident engineer in writing in sufficient time to allow for corrections to be made prior to continuing work.
- C.** Obtain setting bolt templates and setting drawings and install bolts at exact location in the structure.
- D.** Contractor is responsible for maintaining surveying instrument and developing a procedure that permits complete quality control of steel erection. Columns shall be plum and horizontal members shall be level.

PART 2 - PRODUCTS

2.1 Materials:

- A. Unfinished Bolts and Nuts:** Unfinished bolts and nuts shall conform to ASTM Standard A-307 and shall be the regular hexagon-bolt type.
- B. Turned Bolts and Nuts:** Bolts and nuts shall conform to ASTM A - 307.
- C. High Strength Bolts and Nuts:** Bolt and nuts shall conform to ASTM Specification A-325. Bolt and nut dimensions and threads shall be in accordance with American Standard B 18.22 for regular semi-finished hexagon bolts and heavy semi-finished hexagon nuts.
- D. Washers:** Round washers shall conform to American Standard B27.2 Type B. Washers in contact with high-strength bolt heads and nuts shall be hardened in accordance with ASTM Standard A-325. Beveled washers shall be square, smooth, and sloped so that contact surfaces of bolt head and nut are parallel. The diameter of the hole of square-beveled washers shall be 1/16" greater than the bolt size for bolts not larger than 1", and 1/8" greater than the bolt size for bolts larger than 1".

- E. Filler Metal for welding:** Welding electrode for manual shielded metal arc-welding shall conform to AWS Specifications. Bare electrodes and granular flux used in submerged-arc process shall conform to Section A.3.6 of AISC "Specifications for Structural Steel Buildings". Only E70 Series electrodes for manual arc welding and electrodes conforming to AWS A5.17-80 for submerged arc process shall be used for welding A-36 steel.
- F. Shop Paint:** Rust inhibitive primer; TNE MEC 99 Series, or equal conforming to top coat as specified in Section 09900 PAINTING.
- G. Cold Galvanized Compound:** High zinc content compound conforming to Military Specifications MIL-P-21035.

PART 3 EXECUTION

3.1 Erection:

- A.** The framing shall be carried up true and plumb and temporary bracing shall be introduced wherever necessary to take care of the loads to which the structure may be subjected, including erection equipment and its operation. Such bracing shall be left in place as long as may be required for safety. It shall finally be removed by the contractor as part of his equipment. As erection progresses, the work shall be securely connected to take care of all dead load, wind, and erection stresses.
- B.** Set columns in exact position, in alignment, plumb and at proper elevations. Center of base plate shall be within 1/16 inch of true center line of column and pier. Height shall be shimmed and grouted to 1/32 inch true height. Support base plate on leveling nuts until grouted and set.
- C.** Erection bolts used as temporary anchorage for fully welded joints shall be removed after welds are complete and approved. In visible locations holes shall be plug welded solid. Bolted connections using machine bolts shall be peened to deface threads after bolts have been tightened.
- D.** Furnish templates for setting anchor bolts or anchor plates that are to be cast into concrete. Furnish instructions for setting of anchors, connection details, length of exposed bolts, and other information necessary for the proper setting of embedded components.

3.2 Bolted Field Connections:

- A.** Correction of misaligned holes at connections and base plates must be by methods approved by the contracting officer and authorized by the RE. Enlarged holes, when permitted, must be reamed to larger size. Do not burn holes to larger diameter. Mismatched holes in any number make the complete member subject to rejection without further comment.
- B.** ASTM A-325 high strength bolts shall have suitable identification mark on heads. Tightening of nuts shall be in accordance with AISC "Structural Joints using ASTM A-325

or A-490 Bolts". Minimum bolt tension for the size of bolt uses shall be in accordance with tables listed in referenced standards. Tightening shall be accomplished using "calibrated wrench" method.

- C. When assembled, joint surfaces, including those adjacent to the washers, shall be free of scale except tight mill scale. They shall be free of dirt, loose scale, burrs, and other defects that would prevent solid seating of the parts. Contact surfaces with friction-type joints shall be free of oil, paint, lacquer or galvanizing.

3.3 Welded Field Connections:

- A. Each welder shall place his identification mark with paint (or stamp) near the welds he constructed, so that all weldments can be properly identified and associated with the correct welder.
- B. Surfaces to be welded shall be free from loose scale, slag, rust, grease, paint, and any other foreign material except that mill scale withstanding vigorous wire brushing may remain. Joint surfaces shall be free from fins and tears. Preparation of edges by gas cutting shall, wherever practicable, be done by mechanically guided torch.
- C. Clean tack welds and thoroughly fuse with final weld. Remove defective, cracked, or broken tack welds before final welding. Tack welds must be removed from joints where stress is primary, if welding is to be manual.
- D. Weld metal shall be completely sound and free of cracks in any weld or weld pass. Fill all craters to the full cross-section of the weld. Remove weld scale or slag, spatter, burrs, and other sharp or rough projections to leave the surface suitable for non-destructive testing, cleaning, and painting.
- E. Cut apart and re-weld improperly fitted and misaligned parts. Remove cracked welds throughout their length.
- F. Straighten members distorted by heat of welding using mechanical means or by carefully supervised application of a limited amount of localized heat. Heated areas shall not exceed 1,200 degrees Fahrenheit as measured by Tempilsticks. Parts to be heated for straightening shall be free from external stress forces, except when mechanical means are used in conjunction with heat application.
- G. If faulty welding or its removal for re-welding damages the base metal so that, in the resident engineer's (RE's) judgment, it is not in accordance with the intent of the drawings and specifications, remove and replace the damaged material and compensate for the deficiency in a manner acceptable to the RE.
- H. Where work performed subsequently to the making of the deficient weld has rendered the weld inaccessible, or has caused new conditions which make connection of the deficiency dangerous or ineffectual, restore the original conditions by removing welds or members, or both before making the necessary corrections. Another option is to compensate for the deficiency with additional work according to the revised design, approved by the project engineer.

- I. Beam flanges employing full penetration welds shall have 1-1/4" x 3/16" backup plate. Back gouge root pass and weld flush on backside of beam webs where full penetration is specified.
- J. Protect finish material from damage. Shield operations from wind currents. Do not perform welding operation during rainy weather or when temperature is below 40 degrees F.
- K. Field welded joints which are to remain exposed shall be welded continuously regardless of strength requirements. Other joints may be skip welded as necessary to develop strength requirements. In all cases, connection shall be adequate to develop the full strength of largest member connected, regardless of actual requirements.

3.5 Steel Joist: Not Used

3.6 Field Quality Control:

- A. Corrective measures shall be taken when welding is unsatisfactory or indicates inferior workmanship. Chip and grind if the removal of part of the weld or a portion of the base metal is required. Where deposition of additional weld material is necessary, the sides of the area to be welded shall have no less than one to one slope to allow room for depositing new material. Correct defective or unsound welds by the removal and replacement of the entire weld using the following procedures:
 - 1. Excessive Convexity: Remove excess weld metal by grinding.
 - 2. Shrinkage Cracks, Cracks in Base Metal, Craters and Excessive Porosity: Remove defective portions of base and weld material down to sound metal, and deposit additional sound material.
 - 3. Undercutting, Undersize, and Excessive Concavity: Clean and deposit additional weld metal.
 - 4. Overlapping and Incomplete Fusion: Remove and replace the defective portion of the weld.
 - 5. Slag Inclusion: Remove those parts of the welds containing slag. Fill with sound weld metal.
 - 6. Removal of Adjacent Base Metal during Welding: Clean and form full size by depositing weld material.
- B. Field connections shall be visually inspected and physically tested as described above. Every connection must be identified by number and shall be approved by the RE or the third-party testing or certifying agency. Procedure for identifying faulty connections shall be determined by the RE.

3.7 Field Painting:

- A.** Shop painting shall be in accordance with the individual section of the specification. Finished painting shall be as specified in Section 09900 PAINTING. Apply one coat of paint to field welds, and bolts and as necessary to touch up damaged primer. Remove rust and apply same primer as specified.
- B.** Galvanized metals shall be repaired with a cold applied zinc-rich paint. Coat welds, bolts damage to galvanized surfaces, and surface cuts made in the field.

3.8 Clean and Adjust:

After inspection and approval, the steel work shall be thoroughly cleaned of loose scale, rust, splatter, slag, flux, deposit, oil, dirt, and other foreign matter. Exposed steel shall be painted as specified in Section 09900 PAINTING.

END OF SECTION

SECTION 09900

PAINTING

PART 1 - GENERAL

1.1 Work Included:

A. Exterior Painting: Includes all surfaces of the structural steel and the Teepee as indicated. Included are existing coated surfaces made bare by cleaning operations.

B. Interior Painting: Interior surfaces are excluded

C. Mechanical and Electrical Painting: Includes field coating of exterior surfaces.

D. Non-specific Surfaces: Where a space or surface is not specifically indicated to be painted, include the following items unless directed otherwise:

1. Exposed piping, conduit, and ductwork;
2. Supports and hangers.
3. Miscellaneous metalwork and insulation coverings.
4. Cable trays.
5. New zinc-coated strut systems including all-thread rods.

E. Painting Included: Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

1. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.
2. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.
3. Existing coated surfaces that are damaged during performance of the work.

F. Painting Excluded: Do not paint the following unless indicated otherwise.

1. Surfaces not a part of the counterpoise structural steel unless otherwise directed by the drawings.
2. Exposed concrete surfaces.

1.4 Submittals: Submittals shall be in accordance with Contract Documents and shall include:

A. Color Charts: Manufacturer's color chips and charts for use in preparation of color schedule.

B. Manufacturer's Instructions

C. Paint application instructions

D. MSDS: Submit Manufacturer's Material Safety Data Sheets (MSDS) for coatings, solvents, and other potentially hazardous materials.

1.5 Delivery And Storage: Deliver materials in sealed, labeled containers bearing the manufacturer's name, brand designation, specification number, batch number, color, and date of manufacture. Restrict storage and mixing of materials to locations designated by the RE. Products shall be stored in an approved ventilated dry area, protected from contact with soil and from exposure to the elements. Keep products dry at all times.

1.6 Handling: Handle packaging and containers in a manner that will prevent damage to contents.

1.7 Identification of Materials: Containers shall have labels with the following information: Manufacturer's name, Type of paint, Color, Manufacturer's stock number, and Instructions for reducing, where applicable.

1.8 Quality Assurance:

A. Sample Area: A test area of structure elements within an area of from 5 to 10 square feet in size shall be cleaned with the specified material, in accordance with the manufacture's instructions, for the approval of the RE. Sample area must include part of each type of structural element.

B. Inspection and Acceptance: In addition to meeting the previously specified requirements, demonstrate the mobility of scaffolding, enclosures, and other moving components for inspection by the RE. Perform this demonstration after appropriate curing and drying times of the coatings have elapsed and prior to invoicing for final payment.

PART 2 - PRODUCTS

2.1 General: To the maximum extent practicable, use the materials of one manufacturer throughout the project. Primer shall be of suitable type for each surface and compatible in each case with the finish paint.

2.2 Materials Lists: The following products or an approved equal shall be used. Paint other than those listed shall be manufacturer certified that they are of equal or better quality than those listed.

A. Galvanized Metal Primer: No. 850A1 Galvanized Iron Primer Sherwin-Williams

B. Metal Primer:

Rust-O-Lastic, No. 24-R-5 M. A. Bruder & Sons

Kem Kromik, No. B-50-N-2 Sherwin-Williams

Rust-O-Lastic Zinc Dust Primer No. 073-218 M. A. Bruder & Sons

C. Exterior Ferrous Metal Paint:

Dulux Metal Protective Paint Dupont

Metalastic Paint Sherwin-Williams

Noxide Metal Paint Pratt & Lambert

D. Enamel Undercoat:

No. 853 Dulux Ovalite Enamel Undercoat Dupont

Vitralite Enamel Undercoat Pratt & Lambert

P. C. Enamel Undercoat Sherwin-Williams

E. Interior Enamel: Not Used

F. Exterior Flat Wall Paint: Not Used

G. Enamel (Epoxy Resin) Semi-Gloss: Not Used

H. Interior Latex Flat Paint: Not Used

2.3 Evidence of Acceptable Variation: If a product proposed for use does not conform to requirements of the referenced specification, submit for approval to the RE, evidence that the proposed product is either equal to or better than the product specified.

2.4 Color Selection: Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the RE. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

PART 3 - EXECUTION

3.1 Environmental Requirements: Paint shall not be applied to unprotected surfaces in wet weather nor to surfaces on which ice, frost, water, or dampness is visible. Paint shall not be applied in rain, wind, snow, fog or mist nor when the steel surface temperature is below the dew point, resulting in condensation or moisture. When paint is applied in hot weather or thinned in cold weather, ensure that the specified thickness of paint coating is obtained. Do not apply exterior paint in damp, rainy weather nor until the surface has dried thoroughly from the effects of such weather. The temperature of the surface to be painted

and of the surrounding air temperature shall be maintained between 45° and 95° F during the application and drying period. Surfaces shall be dry before paint is applied. Surface to be painted shall be clean, dry, smooth and adequately protected from dampness.

A. Exterior Paint: Exterior paint shall not be applied when the temperature is lower than 40° F or expected to fall below this temperature. Interior paint shall not be applied when the temperature is lower than 60° F or expected to fall below this temperature.

B. Interior Paint: Not Used

C. Metallic Surfaces: Do not paint steel which is at a temperature which can cause blistering, porosity, or otherwise be detrimental to the life of the paint.

3.2 Preparation

A. Mounted Hardware: Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixture, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials to original condition and repair damaged items.

B. Surfaces: Surfaces shall be inspected in regard to their suitability to receive a finish. In the event that imperfections due to materials or workmanship appear on surfaces, appropriate corrections shall be made at no additional cost to the Government. Remove dirt, splinters, loose particles, grease, oil, and other substances deleterious to coating performance as specified for each substrate.

C. Protection: Products and materials placed prior to painting shall be removed or protected. Remove protection upon completion of painting.

D. Cleaning of Surfaces: Surfaces to be painted shall be cleaned as required to remove dust and dirt.

1. **Cleaning Ferrous Surfaces** - Ferrous surfaces, interior and exterior, that have not been shop-coated shall be solvent-cleaned to remove oil and grease, then mechanically cleaned by power wire-brushing or blast cleaning to remove loose rust, loose mill-scale and other foreign substances. Blast cleaning shall conform to Steel Structures Painting Council Specification SSPC-SP-6 for commercial sandblasting. Power tool cleaning shall conform to Steel Structures Painting Council Specification SSPC-SP-3. Cleaning shall be scheduled to permit priming of the cleaned areas on the same day. In the event the cleaned surfaces are left unprimed until the formation of corrosion, the affected areas shall be cleaned again. Minor amounts of residual rust that cannot be removed except by white metal blast-cleaning, and tight mill-scale that cannot be removed by applying a sharp knife to any edge, will be permitted. After cleaning, one coat of paint shall be applied to a minimum dry film thickness of 1 mil. Shop-coated metal shall be protected from corrosion before and after installation by treating corroded areas immediately upon detection. Rust spots, and spots where shop coat has been abraded, shall be sanded to bright metal and recoated with a primer.

2. Fabricated and Assembled Items - Fabricated and assembled items which are normally cleaned and primed in accordance with the manufacturer's standard practice may be exempted from the requirements for surface preparation and first coat specified in elsewhere or on the drawings upon specific request by the contractor and approval by the contracting officer. Similarly, items which are normally painted with a complete coating system in accordance with the manufacturer's standard practice may be exempted entirely from the surface preparation and painting requirements herein, provided the finish coat is of acceptable color and quality and is touched up as necessary in the field. Requests for exemption shall be accompanied by a description of the manufacturer's standard coating including surface preparation, type of paint, dry film thickness and whether baked or air-dried.
3. Nonferrous Metal Surfaces - All nonferrous metal surfaces, such as aluminum alloy (except anodized), copper, zinc-copper-alloy, and zinc-coated surfaces, including nonferrous surfaces not to be painted, shall be solvent-cleaned as necessary to remove all oil, grease or other foreign substances. After cleaning, all nonferrous surfaces to be painted shall be treated with vinyl type wash coat as hereinafter specified. Painting to protect aluminum from contact with dissimilar materials should be specified under the division of the specification covering the specific item. All zinc-coated metal shall be protected from corrosion before and after installation by treating cut, scarred, corroded, or abraded spots immediately upon detection. Such spots shall be thoroughly wire-brushed, cleaned and smoothed, treated with vinyl wash coat or primed with zinc dust or zinc dust-zinc oxide metal primer, and then painted when necessary with a finish color coating which will match the color of adjoining surface.
4. Preparation of Wood and Plywood Surface
 - a. Surface Cleaning - Surfaces shall be free from dust and other deleterious substances and in a condition approved by the RE prior to receiving paint or other finish. Do not use water to clean uncoated wood.
 - b. Removal of Fungus and Mold - Wash existing coated surfaces with a solution composed of 3 ounces (2/3 cup) trisodium phosphate, 1 ounce (1/3 cup) household detergent, 1 quart 5% sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.
 - c. Prime Coat On Exterior Surfaces - Prime coat before wood becomes dirty, warped, or weathered.
 - d. Cracks and Nail Heads - Set and putty stop nail heads and putty cracks after the prime coat has dried.

E. Touch-Ups: Scratches, abrasions or other disfigurements shall be properly prepared and touched up. Remove foreign matter from prime coats before proceeding with subsequent coats. Spot priming shall be featheredged into adjacent coatings to produce a smooth and level surface.

3.3 Application

A. Prime Coat: Miscellaneous metal and other materials which have been prime coated shall be touched-up where the shop coat has been damaged by welding or abrasion during the handling and erection operations. Touch-up primed fasteners and welds which are unpainted after assembly and erection.

B. Coating Application: Thoroughly work coating materials into joints, crevices, and open spaces. Touch up damaged coating before applying subsequent coats.

1. Drying Time - Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying. Provide each coat in specified condition to receive next coat.
2. Primers and Intermediate Coats - Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by the manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coats. Each coat shall cover the surface of the preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.
3. Finished Surfaces - Provide finished surfaces free from runs, drops, voids, holidays, ridges, waves, laps, brush marks, and variations in colors.

C. Paint Utensils: Paint shall be applied by a brush, roller or spray in accordance with the manufacturer's directions. Use the type of brushes best suited for the type of materials being applied. For covers on rollers use carpet with velvet back and of high pile sheep's wool or use short hair covers, as best suited for material specified.

D. Thinning of Paints: Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory for the type of paint being used. Obtain written permission from the RE to use thinners. The written permission shall include quantities and types of thinners to use.

E. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise. Coating thickness where specified, refers to the minimum dry film thickness.

F. Coatings for Surfaces not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

G. Existing Surfaces Damaged: During performance of the work, including new patches in existing surfaces, coat surfaces with the following:

1. One coat of primer.
2. One coat of undercoat or intermediate coat.
3. One top coat to match adjacent surfaces.

H. Paint Techniques: Each coat of paint shall be applied smoothly, worked out evenly and allowed to dry completely before the subsequent coat is applied. Finished work shall be uniform and of the specified color. Paint shall completely cover, be smooth and free from runs, sags, clogging or excessive flooding. Make edge of paint adjoining other materials or colors sharp and clean without overlapping. Where high gloss enamel is used, lightly sand undercoat to obtain a smooth finish coat. Painting shall be completed according to the manufacturer's written instructions. Apply spray paint uniformly with suitable equipment. Paint shall be applied to a minimum dry film thickness of five mils. Tint each coat of paint slightly lighter or darker than the preceding coat or the finish coat.

I. Commencement: Painting shall commence when other operations detrimental to finish painting have been completed and the areas have been approved for painting.

J. Precautions: Soiled cleaning rags and waste shall be disposed of daily at the close of each day's work or stored in metal containers with tight fitting covers. Appropriate precautions shall be taken to preclude rags or other debris from entering the runway and taxiway safety areas. An appropriate number of sand buckets shall be provided at all times for use in the event of fire. "No Smoking" signs shall be posted as required or directed.

K. Exterior Ferrous Metal Surfaces: Galvanized metal including structural steel, rigid steel metal conduit exposed metal plates, angles, shapes, and hangers shall be coated as follows:

- 1st Coat Metal Primer (if not shop primed)
- 1st Coat Galvanized metal primer
- 2nd Coat Exterior ferrous metal paint
- 3rd Coat Exterior ferrous metal paint

L. Interior Surfaces: Not Used

3.4 Final Cleaning: Upon completion of work, remove staging, scaffolding and containers from the site. Remove paint spots, oil or stains from surfaces not to be painted, and leave facility clean and acceptable to the RE.

END OF SECTION

REPAIRING DAMAGED HOT-DIP GALVANIZED COATING

PART 1 – GENERAL

- 1.1 Scope:** Excessively damaged items, as determined by the RE, shall be returned to the supplier for regalvanizing. When approved in writing by the RE, hot-dip galvanized coatings shall be repaired in accordance with this division of the specifications.
- 1.2 Applicable Documents:** ASTM A 780-80 Standard Practice for Repair of Damaged Hot-Dip Galvanized Coatings
- 1.3 Submittals:** Submit manufacturer's product literature.

PART 2 – PRODUCTS

- 2.1 Material:** All damaged hot-dip galvanized coatings of reamed or field drilled holes shall be repaired using a zinc-rich paint. As a minimum, the zinc-rich paint dried film shall contain 94% zinc dust by weight and conform to ASTM A780-80.
- 2.1.1 Coat Thickness:** 3 Mils Minimum (Dry Film)
- 2.1.1.1** The following product, or approved equal, may be used:
Z.R.C. – Liquid cold galvanizing compound with shiny finish by "ZRC Products Comp.", Quincy MA, (617) 773-1180.

PART 3 – PRODUCTS

3.1 Surface Preparation

- 3.1.1** Surfaces to be reconditioned shall be clean, dry, and free of oil, grease, and corrosive products.
- 3.1.2** Surface preparation shall be in accordance with ASTM A780, ANNEX A2, AWS C2.2-67 and product manufacturer specifications.
- 3.1.3** To ensure a smooth coating, surface preparation shall extend into the undamaged galvanized coating. The method and extent of the surface preparation shall be approved by the RE.

- 3.2 Application:** Apply coatings as recommended by the manufacturers and listed specifications.

- 3.3 Quality Assurance:** Dry film thickness shall be measured, at locations selected by the RE, using a magnetic or electromagnetic gauge. All measurements shall be taken in the presence of the RE and recorded.

3.3.1 Resurface rejected areas as required.

END OF SECTION

DRAFT

SECTION 15000

MECHANICAL - GENERAL

PART 1 - GENERAL

1.1 Work Included - Except as modified in this Division, applicable provisions and requirements and other contract documents apply to work in all Mechanical Divisions of this specification, including Divisions 15000, 15200, 15300, 15400, and 15600.

1.2 Scope of Work

- (1) Contractor shall remove the existing duct between the equipment building fan and RF box as part of the demolition phase.
- (2) Contractor shall furnish and install duct between the equipment building and the RF box following installation of the new counterpoise. The new duct shall match the duct that was removed in type, size, capacity, insulation, and configuration.

1.3 Mechanical Divisions - Mechanical divisions of this specification shall include the following:

15000 Mechanical – General
15600 Ventilating Systems

1.4 Applicable Documents - The current issues of the following documents in effect on the date of the Request-for Proposal form a part of this specification and are applicable to the extent specified herein.

1.4.1 American Concrete Institute (ACI)

301 Structural Concrete for Buildings
318 Building Code Requirements for Reinforced Concrete

1.4.2 American Society for Testing and Materials (ASTM) Not Used

1.4.3 American National Standards Institute (ANSI) Not Used

1.4.4 American Society of Heating, Refrigerating, and Air Conditioning Engineers - ASHRAE Handbook, Equipment Volume

1.4.5 Air Movement and Control Association: AMCA Standards

1.4.6 Federal Specifications: Not Used

1.4.7 National Fire Protection Association (NFPA)

NFPA 30 Flammable and Combustible Liquids Code

NFPA 58 Standard for the Storage and Handling of Liquefied Petroleum Gases
NFPA 70 National Electrical Code
NFPA 329 Underground Leakage of Flammable and Combustible Liquids

1.4.8 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) SMACNA Low and High Pressure Duct Construction Standards

1.5 Acronyms:

CFM-Contractor Furnished Materials
COR-Contracting Officer's Representative
E/G-Engine Generator
GFM-Government Furnished Materials
NEC-National Electrical Code
NFPA-National Fire Protection Association
OSHA-Occupational Safety and Health Administration
RE-Resident Engineer
SOW-Statement of Work

1.6 Space Conditions

1.6.1 Existing Conditions - The drawings indicate certain information pertaining to existing conditions, including equipment and other work, which has been taken from available drawings. Such information is not guaranteed as to its accuracy and completeness. The Contractor shall verify all existing conditions at the site prior to commencement of work. Verify location of all utilities prior to excavation and trenching. Contractor shall be responsible for restoration of all utilities at no additional cost to the Government.

1.6.2 Indoor Work - Any work necessary inside the building to remove or install the duct shall proceed in such a manner as to minimize the effect on all FAA operations, and shall protect the delicate electronic equipment inside the building. Contractor shall take all actions necessary to minimize the spread of dust and flying particles.

1.6.3 Piping and Equipment - Any equipment and materials needed inside must be introduced into the building in such manner as not to cause damage to any equipment or the structure. All apparatus shall be installed essentially as shown on the drawings. Any changes of layout due to variations in configuration of apparatus must be accomplished at no additional cost to the Government.

1.6.4 Accessibility – New duct accessibility shall be equal to or greater than provided in the original installation.

1.6.5 Dimensions - The Contractor, before commencing work, shall verify all dimensions at the site.

1.7 Cutting and Repairing - Contractor shall perform all cutting and repairing necessary for installation of specified work. Where any existing work is removed by Contractor, surfaces exposed by such removal shall be repaired, painted and/or otherwise finished as required to match existing adjacent work. Structural members shall not be cut unless specifically so shown or noted on drawings, or authorized by the FAA.

1.8 Shop Drawings

1.8.1 Submittals - Before any equipment is ordered or material fabricated, five (5) copies of shop drawings and manufacturer's complete performance and descriptive data shall be submitted to and approved by the RE. All manufacturer's data and shop drawings shall be submitted in loose leaf binders. Manufacturer's performance and descriptive data shall be submitted on all new equipment and materials, including but not limited to: Ductwork.

1.8.2 Approval - Approval of shop drawings, or other data submitted in accordance with submittal requirements, does not ensure that the RE attests to the performance or dimensional accuracy and suitability of the equipment or material. Neither does approval invalidate the plans and specifications if in conflict unless a letter requesting such change is submitted and approved.

PART 2 - PRODUCTS

2.1 Equipment and Materials

2.1.1 Quality - All equipment and materials (other than existing which is to be reused) shall be as specified herein. Material shall be new and free from all defects and imperfections that might affect the serviceability of the finished product.

2.1.2 Type Products Manufacturer - All new material of one type shall be the product of one manufacturer.

2.2 Government Furnished Materials (GFM)

Government Furnished Materials, (GFM), if any, will be as described in the Statement of Work (SOW) and as shown on the drawings.

PART 3 - EXECUTION

3.1 Guarantees

3.1.1 Contractor shall guarantee that if any workmanship or material required by this project proves defective or any part of the installation fails to perform as specified, Contractor shall remedy such defects without expense to the Government for service, materials, parts and labor, for a period of one year after final settlement.

3.1.2 Contractor shall provide and install new ductwork between the equipment room fan and the RF box.

3.2 Utilities

- 3.2.1** Before starting any other work on this project, the Contractor shall verify the exact location of all existing utilities to which he is to make connections for this project. If for any reason, conditions should appear that will adversely affect the proper installation and operation of the systems required for this project, such conditions shall be reported to the RE in writing for his decision.
- 3.2.2** All expenses for connections, extensions, temporary services, cutting and patching of paving, trenching, backfilling and all other work required for installation and connection to the various utility lines, shall be included in the Contractor's bid price.
- 3.2.3** All materials and methods of installation shall be in accordance with the National Plumbing Code, National Electrical Code, National Fire Protection Association, FAA electrical specifications, municipal codes, requirements of local utility companies and any other authorities that may have lawful jurisdiction pertaining to any portion of this project.
- 3.2.4** The Contractor shall procure all necessary permits, licenses and inspections required to accomplish the work and shall pay the lawful fees therefore.

3.3 Storage and Protection of Materials

- 3.3.1** Contractor shall be responsible for the transportation of his materials to and from the job. All storage space locations shall be subject to approval of the RE prior to use for storage of equipment or materials.
- 3.3.2** Materials stored outside the building shall be subject to approval of the RE prior to final installation.
- 3.3.3** All materials, equipment and other work, whether incorporated in the structure or not, shall be protected at all times against the weather (rain, wind, frost, ice or heat) so as to maintain such work free from possible damage. At the end of each workday, all work likely to be subject to damage from weather shall be covered or otherwise protected.
- 3.3.4** All material, equipment, piping, insulation or other work, which is damaged, abused or otherwise harmed by weather or workmen during life of this contract shall be replaced or repaired by the Contractor as directed by the RE at no additional cost to the government.
- 3.3.5** All openings provided in building roof and exterior walls shall be provided with temporary watertight covers, until such time as openings have been repaired or equipment required for such openings, has been installed.

- 3.4 Start-Up** – The Contractor shall assure by test that the new duct installation operates properly in conjunction with the existing fan prior to final acceptance by the RE.

END OF SECTION

SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 Work Included

A. General

1. Furnish material, equipment, labor, supervision, testing of equipment and incidentals necessary for complete and operational systems as specified herein.
2. This section concerns all other sections in Division 16 and shall be considered a part of each of those sections as if written in their entirety.
3. Order of Precedence: Materials and equipment shall comply with all requirements of the contract documents. Materials furnished by the contractor shall be new, the standard products of manufacturers regularly engaged in the production of such materials, and of the manufacturer's latest designs that comply with the specification requirements. If electrical material and equipment requirements conflict, the order of precedence for selection shall be as follows: FAA Specifications and Standards, Contract Specifications, Contract Drawings. Then in continuing order of precedence, Military Specification Federal Specifications, NFPA-70 "National Electrical Code", IEEE Standards, UL Standards and NEMA Standards. Wherever standards have been established by Underwriters' Laboratories, Inc., the material shall bear the UL label.
4. Replacement and spare parts shall be provided as indicated in other sections of Division 16.

B. Provide the following electrical equipment and systems: Equipment, wiring devices, and electrical connections required for installation of electrical equipment.

1. Conduit and raceways for data or communication cables (RG-223 & 1/4" Heliac)
2. Raceways and wiring for power and control, including underground duct banks
3. Grounding systems
4. Cutting and patching for electrical construction

C. Minor Departures: Minor departures from exact dimensions shown in electrical plans may be permitted where required to avoid conflict or unnecessary difficulty in placement of a dimensioned item, provided all contract requirements are met. The Contractor shall promptly obtain approval from the FAA prior to undertaking any such departures, and shall provide appropriate documentation of the departure.

1.2 Reference Standards

- A. General: Comply with the standards in effect as of the date of the Contract Documents as applicable to the extent specified in this Division. The rules, regulations and reference specifications enumerated in these specifications shall be considered as minimum requirements. Adherence to other standards shall not relieve the contractor from furnishing and installing higher grades of materials and workmanship when so required by this specification. Adherence to this

specification shall not relieve the Contractor from furnishing and installing higher grades of materials and workmanship when so required by the Contract Drawings or special contracts provisions. Electrical work shall be executed in accordance with local, state, and national codes, ordinances, and regulations that have jurisdiction authority over the work. If Conflicts occur between FAA documents and any other document, the FAA requirements shall be used.

- B. American Standard for Testing and Materials (ASTM)
 - 1. D1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort
- C. Federal Aviation Administration (FAA)
 - 1. STD-019e - Lightning and Surge Protection, Grounding, Bonding, and Shielding Requirements for Facilities and Electronic Equipment
 - 2. STD-020b - Transient Protection, Grounding, Bonding, and Shielding Requirements for Electronic Equipment
 - 3. C-1217f - Electrical Work, Interior
 - 4. FAA-C- 1391b - Installation and Splicing of Underground Cables
- D. Institute of Electrical and Electronic Engineers (IEEE)
 - 1. 519 Recommended Practices and Requirements for Harmonic Control and Electrical Power System.
 - 2. 1100 Power and Grounding Emerald Book
- E. National Electrical Manufacturers Association (NEMA)
 - 1. WC70-00 Non-Shielded Power Cable 2000V or Less
 - 2. WC26-00 Bi-national Wire and Cable Packaging Standard
- F. National Fire Protection Association (NFPA)
 - 1. 70 National Electrical Code (NEC), latest edition
 - 2. 780 Standard for Installation of Lightning Protection Systems
- G. National Electrical Contractors Association (NECA)
 - 1. 1-2000 Standard of Installation
- H. Occupational Safety and Health Administration (OSHA)
 - 1. 29CFR1907 Description and Requirements for a Nationally Recognized Testing Laboratory (NRTL)
- I. Underwriters Laboratories (UL)
 - 1. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors
- J. National Electrical Safety Code (NESC)
- K. American National Standards Institute ANSI
- L. International Building Code (IBC)
- M. Rural Electrification Association (REA)
- N. Insulated Power Cable Engineers Association (IPCEA)
- O. Association Edison Illuminating Companies (AEIC)
- P. Local Utility Companies

Q. Federal Specifications:

1. J-C-30 Cable and Wire, Electrical (Power, Fixed Installation)
2. L-T-1512 Tape, Wrapping, Pressure-Sensitive; Adhesive Tape 1512
3. L-P-390 Plastic Molding and Extrusion Material, Polyethylene and Co-polymers Low, Medium Density
4. W-C-582 Conduit, Raceway, Metal and Fittings: Surface
5. W-C-586 Conduit Outlets, Boxes, Bodies, and Entrance Caps, Electrical; Cast Metal – For Shore Use
6. W-F-406 Fittings for Cable, Power, Electrical and Conduit, Metal Flexible
7. W-F-408 Fittings for Conduit, Metal, Rigid (Thick-Wall and Thin Wall (EMT-Type)
8. W-S-610 Splice, Conductor
9. HH-I-510 Insulation Tape, Electrical, Friction
10. HH-I-595 Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic, or Low Temperature Application
11. W-C-563 Conduit, Metal, Rigid; and Bends and Elbows, Electrical Conduit: Thin Walled Type (EMT)
12. W-C-566 Conduit, Metal, Flexible
13. W-C-581 Conduit, Metal, Rigid and Intermediate; Coupling, Elbow, Nipple, Electrical Conduit: Zinc-Coated
14. W-C-1094 Rigid Non-Metallic Conduit (PVC): Schedule 80 high impact, polyvinyl chloride, Underwriters Laboratory Listed UL 651

- A. Obtain and pay for all permits, licenses, and inspection completion as required by law for the completion of the work. Certificates of approval shall be secured, paid for and delivered to the Contractor before receiving the acceptance of the work.
- B. The location of materials, equipment, devices, and appliances indicated are approximate and subject to revisions at the time of installation. The Contract Drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.
- C. Should project conditions require any rearrangement of work, or if equipment or accessories can be installed to a better advantage than the general arrangement of work on the plans, the Contractor may, before proceeding with the work, prepare and submit plans of the proposed rearrangement to the Project Engineer (PE) or designee.
- D. Equipment Size: Electrical equipment size indicated on the Contract Drawings is based on a particular manufacturer. It is the responsibility of the Contractor to verify that the equipment he proposes to furnish will fit in the space indicated on the Drawings.
- E. Equipment Coordination: Equipment furnished and installed under other Sections of this Specification and by the Contractor shall be coordinated with equipment furnished and installed under this section.
- F. Electrical work shall be performed under the supervision of a master Electrician who holds a valid license recognized by the cognizant authority.
- G. Code Violations: Perform work to meet or exceed the requirements of the National Electrical Code and other applicable statutes, ordinances, codes, and regulations of the governmental authorities having jurisdiction. Resolve any code violations discovered in

the Contract Documents with the Contracting Officer (CO) prior to award of the Contract.

1. After the award of the Contract, make any corrections or additions necessary for the compliance with applicable codes at no additional cost to the Contractor.
2. Corrections or additions require RE and CO approval prior to implementation.

1.3 Guarantees

- A. The work shall be guaranteed for one year from the date of final acceptance of the project and during that period the Contractor shall make repair at his expense any faults or imperfections that may rise due to defects of omissions in materials or workmanship.

1.4 Work in Related Sections - Not Used

1.5 Submittals

- A. Component catalog numbers and manufacturer's data sheets, including pertinent data identifying each component by the item number and nomenclature, as specified.
- B. Within 5 days after the Notice of Award (NOA) of the contract and before orders are placed or shop drawings are submitted, the Contractor shall submit to the FAA a list of equipment and principal materials specified. Give names and manufacturer's catalog and model numbers and other such supplemental information as necessary for identification.
- C. Project Record Documents: Maintain at the job site a separate set of redline bond prints of the Contract Documents (specifications, drawings, change orders, addendums) for the purpose of recording the system and dimension changes of those portions of work in which actual construction is significantly at variance with the Contract Documents. The Contractor shall record changes for both GFE and Contractor provided equipment. Upon acceptance of the project, submit documents to the FAA, with verification of data accuracy. Mark the Record Drawings with colored pencil. Prepare the Record Drawings as the work progresses. Upon completion of work, submit Record Drawings clearly indicating the following:
 1. Locations of devices, conduits, equipment, electrical 1-line and other pertinent items; Indicate the depth of buried ducts and direct burial cables.
 2. Schematic and interconnection wiring diagrams of the completed power and control system incorporating the data derived from the equipment shop drawings, and the cable and conduit schedule. The drawings shall be detailed to wire and terminal block numbers, conductor color coding, device designations, locations, and reflect identifications established at the site.
- D. Samples: When the adequacy, quality, and safety of a material will be better demonstrated and it will expedite approval, provide single samples of items proposed for use. Conform to the procedures specified.
- E. Prior to submittal, all shop drawings shall be checked for accuracy and Contract requirements. Shop drawings shall bear the date checked. In addition, each shop

drawing submitted shall include a copy of the applicable specification section, with addendum updates included, and all referenced and applicable sections, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviation from specification requirements. Check-marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portion of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detail written justification for each deviation. Failure to include a copy of the marked up specification sections, along with justifications for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further explanation.

- F. The Project Engineer's review shall be only for conformance with the design concepts of the project and compliance with the specification and Contract Drawings. The Project Engineer's review shall not change the requirements of the Contract Documents, nor shall that review alleviate the Contractor of errors in the shop Drawings. The responsibility of, or the necessity of, furnishing materials and workmanship require by the Specification and Contract Drawings, which may not be indicated in the sop drawings, is included as work under this Section.

- E. Test Report: Not Used

1.6 Quality Control

- A. General: The rules, regulations and reference specifications enumerated herein shall be considered as minimum requirements and shall not relieve the Contractor from furnishing and installing higher grades of material and workmanship than are specified herein or when so required by the Contract Drawings. Materials, appliances, and equipment provided shall meet the requirements of the Underwriters Laboratories, Inc. (UL), Electrical Testing Laboratories (ETL) and other standard organizations. . Worked called for by specification, reference documentation, or drawings is required the same as required by all. Where a conflict of interest exist between specifications, reference documents, or drawings the more stringent requirement of all shall apply unless specifically approved in writing by the engineer of record.
- B. Electrical Contractor's Qualification: Installer shall have successfully completed within the last 3 years at least 5 projects similar in type and size to this project and shall be certified by the manufacture for all systems installed. Names locations contacts and phone numbers of the projects shall be submitted with submittals for approval. Use adequate numbers of skilled workmen, trained and experienced in their crafts, and who are familiar with the specifications and methods of performing the work in this Division.
- C. Licensed: The electrical foreman shall be a licensed electrician.
- D. Workmanship: Work shall be performed in accordance with quality, commercial practices. The appearance of finished work shall be of equal importance with its

operation. Material and equipment shall be installed based upon the actual dimensions and conditions at the project site. Locations for materials or equipment requiring exact fit shall be field measured. Conduit, transformers, and motors shall be isolated to avoid unacceptable noise levels from objectionable vibrations from all systems. Per NEC 110.12

- E. Contract Drawings: Where the electrical drawings indicate (diagrammatically or otherwise) the work intended and the function to be performed even though some minor details are not shown, the Contractor shall furnish all equipment, material (other than Government furnished items), and labor to complete the installation work and accomplish all indicated functions of the electrical installation. Further, the Contractor shall be responsible for taking the necessary actions to ensure that all electrical work is coordinated and compatible with all other disciplines, general, NFPA 70 latest edition, and FAA Standards.
- F. View Other Sections: The Contractor is to review other sections of this specification to determine electrical requirements for equipment furnished under those sections. Coordinate all electrical rough-ins and connections for proper function of this equipment.
- G. Minor Departures: Minor departures from exact dimensions shown in the electrical plans may be permitted where required to avoid conflict or unnecessary difficulty in placement of a dimensioned item, provided all contract requirements are met. The Contractor shall promptly obtain approval from the FAA prior to undertaking any such proposed departure.
- H. Listing and labeling: Provide products specified in the section that are listed and labeled:
 - 1. The terms "Listed and Labeled" as defined in the National Electrical Code, (latest edition) Article 110.
 - 2. Listing and Labeling Agency Qualifications: NRTL as defined in OSHA Regulation 1910.7.
 - 3. Field installed nameplates shall conform to Division 16195, Electrical Identification.
 - 4. Nameplates on manufactured items shall be aluminum or type 304 stainless steel not less than 20 US Gauge, riveted, bolted to the manufactured item, with nameplate data engraved or punched to form a non-erasable record of the equipment data.

3.8 Delivery, Storage, and Handling:

Follow the Manufacturer's directions for the delivery, storage, and handling of equipment and materials. Tightly cover equipment and materials and protect from dirt, water, chemical or mechanical injury and theft. Damaged equipment and material will not be acceptable. Upon installation, protect the materials until work is completed and accepted by the Contractor.

3.9 Sequencing and Scheduling

- A. Coordinate electrical equipment installation with other building components.
- B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for electrical installations.

- C. Coordinate installing required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- D. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the work. Coordinate installing large equipment requiring positioning prior to closing in the building.
- E. Coordinate connecting electrical service to components furnished under other Sections.
- F. Coordinate connecting electrical systems with exterior underground and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate installing electrical identification after completion of finishing where identification is applied to field-finished surfaces.

PART 2 - PRODUCTS

2.1 Products

- A. Manufacturer's Recommendation: Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendation prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish the recommendations shall be cause of rejection of the equipment or material.
- B. Provide equipment and material of sizes, capacities, power ratings and dimensions as indicated on the Contract Drawings and in drawing schedules.
- C. All structural and miscellaneous steel used in connection with electrical work and located out-of- doors or in damp locations shall be hot dipped galvanized unless otherwise specified. Included are underground steel pull box covers and similar electrical items. Galvanizing shall average 2.0 ounce per square foot and shall conform to ASTM A123.
- D. Approval of materials and equipment will be based on the manufacturer's printed data. The label or listing of Underwriter's Laboratories, Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this listing, the Contractor may submit a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures of the Underwriter's Laboratories, Inc., and that the materials and equipment comply with all Contract requirements. A manufacturer's statement indicating complete compliance with the applicable Federal Specification or Standard of the American Society for Testing and Materials, National Electrical Manufacturers Association or other Commercial Standards, will be acceptable proof of such compliance.
- E. Manufacturer's Standard Products: Use colors prescribed by NFPA 70.

1. Materials and equipment shall conform to respective publications and any other

requirements specified below. The Contractor shall furnish all materials. Materials and equipment, to be acceptable, must comply with all contract requirements. Materials to be furnished by the Contractor under this specification shall be of manufacturer's regularly engaged in the production of such material and of the manufacturer's latest designs that comply with the specification requirements.

2.2 Concrete Equipment Bases

- A. Forms and Reinforcing Materials: As specified in 03301 "Cast-In-Place Concrete" Section of this Specification.
- B. Concrete: 3000 psi, 28-day compressive strength as specified in 03301 "Cast-In-Place Concrete" Section of this Specification.

2.3 Electrical Identification: Provide electrical Identification as specified in Section 16195, "Electrical Identification."

2.4 Support for Electrical Equipment: Channel and Angle Supports, Raceway Supports, Sleeves and Fasteners: As specified in Section 16190, "Supporting Devices."

PART 3 - EXECUTION

3.1 Equipment Installation Requirements

- A. All materials and equipment shall be installed in accordance with the Contract Drawings, and with FAA-C-1217f, and FAA-STD-019e.
- B. Coordinate electrical work with that of other trades so that:
 - 1. Interference between electrical and other specialty trades is to be avoided.
 - 2. Maintain clearances and advise other trades of clearance requirements for operation, repair, removal and testing of electrical equipment.
 - 3. All electrical materials and equipment shall be kept as close as possible to ceilings, walls and columns to occupy the minimum amount of space.
 - 4. Furnish and install all offsets, fittings and similar items necessary to accomplish the requirements of coordination without additional expense.
 - 5. Equipment required to be temporarily disconnected and relocated shall be carefully removed, stored, cleaned, reinstalled, reconnected, and made operational.
- C. Where manufacturer's recommended installation methods conflict with contract requirements, difference shall be resolved by the PE Designee.
- D. The installation shall be accomplished by skilled licensed workers regularly engaged in this type of work. Where required by local regulation, the workers shall be properly licensed.
- E. Install components and equipment to provide the maximum possible headroom where mounting heights or other location criteria are not indicated.

- F. Install items level, plumb, parallel, and/or perpendicular to other building systems and components, except where otherwise indicated.
 - G. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
 - H. Maintain the waterproof and fire proofing integrity of conduit penetrations through the roof, exterior walls, and floors.
 - I. The drawings indicate certain information pertaining to surface and subsurface obstructions that has been taken from available site drawings. Such information is not guaranteed as to accuracy of location or completeness. Coordinate trenching operations in accordance with Section 02325 "Trenching, Excavating, Compacting for Underground Utilities."
 - J. Equipment shall be properly anchored and supported to resist shear and overturning moments for IBC Section 1613, Earthquake Loads, Site Class D.
- 3.2 Excavation: For excavation for installation of electrical utilities (power and control), refer to Sections 02200 Earthwork, 02220 Installation of Underground Cable Systems, and 02324 Trenching.
- 3.3 Installation
- A. Contract Drawings: Where the Contract Drawings schematically indicate the work, diagrammatically or electrically, ensure that the electrical and communications work is coordinated and compatible with, Mechanical and Structural work.
 - B. Support and Fastening: Unless otherwise indicated, securely fasten electrical items and their supporting hardware to the building structure in accordance with section 16190, "Supporting Devices."
 - C. Install concrete pads and bases for electrical equipment in accordance with Section 03301, "Cast- In-Place Concrete."
 - D. Install identification devices where required in accordance with the requirements of Section 16195, "Electrical Identification."
 - E. Wiring Methods:
 - 1. General: All wiring shall consist of insulated copper conductors installed in metallic raceways unless otherwise specified.
 - 2. Conductor routing: Panelboards, surge arresters, disconnect switches, etc., shall not be used as raceway for conductor routing other than conductors that originate or terminate in these enclosures. Isolated ground conductors will be allowed to traverse these enclosures.
 - 3. Conductor separation: Power conductors shall be routed separately from all other conductor types. Route power conductors and other conductors in separate raceways, or by metallic divider between the power conductors and any other conductors in the

same raceway, in these enclosures. Isolated ground conductors will be allowed to traverse these enclosures

- a. Power conductors of different voltages less than 600V shall be in separate duct.
 - b. Power cables of less than 600 Volts shall not be installed in the same duct with control, telephone, or signal type cables.
4. Neutral conductor: Shared/common neutrals shall not be permitted, i.e., each overcurrent protection device shall have its own separate neutral conductor. Neutral conductor sizes shall not be less than the respective feeder or phase conductor sizes.

F. All conduit openings through floors shall be both airtight and watertight.

G. Seal equipment or components exposed to the weather and make watertight and rodent proof. Protect equipment outlet and conduit openings with temporary plugs of caps at all times work is not in progress.

3.4 Cutting and Patching

- A. Cut, channel, chase, and drill floors, walls, and other surfaces necessary for electrical installations. Perform cutting by skilled mechanics of the trades involved.
- B. Repair disturbed surfaces to match adjacent undisturbed surfaces.

3.5 Testing

- A. General: Unless otherwise indicated, the contractor shall furnish all test instruments; materials and labor necessary to perform tests designated in Sections of this Division.
- B. Calibration: All tests shall be performed in the presence of the PE Designee. All instruments shall have been calibrated within a period of two years preceding testing. Calibrations shall be traceable to applicable industry recognized standards.
- C. Tests:
 1. An interim operating and performance test shall be performed for each major equipment item after installation is complete and before the item is placed in service.
 2. After mechanical systems have been completely installed and balanced, test each system for proper operation.
 3. Tests shall be conducted in the presence of the FAA under design conditions to ensure proper sequence and operation throughout the range of operation.
 4. Make adjustments as required to ensure proper functioning of the systems.
 5. Special tests on individual systems are specified under individual sections.
 6. Provide 5 days written notice to the FAA for major tests. Contractor shall demonstrate, to the PE Designee's satisfaction, proper operation of control devices by simulating actual operating conditions.
 7. Not Used.
 8. Perform the tests specified and other tests necessary to establish the adequacy, quality, safety, completed status, and suitable operation of each system.
 9. Repair or replace equipment that does not meet test requirements and retest. Notify the FAA in writing 5 days prior to conducting tests.

D. Instructions: After final tests and adjustments have been completed, fully instruct the

FAA and other personnel as directed by the FAA in details of operation and maintenance of electrical equipment.

- E. For grounding tests, refer to Section 16060 "Grounding and Bonding."
- F. For load balancing tests, refer to Section 16470 "Panelboards and Overcurrent Protective Devices."
- G. For conductor tests, refer to Section 16120 "Wire and Cables."
- H. Underground Cable Test: Test in accordance with FAA-C-1391b. Testing of cable shall be performed before and after installation.

3.6 Delivery, Storage and Handling

- A. Clean and wipe the interior of conduit, pullboxes and panelboards before proceeding with the wiring.
- B. Do not install damaged, broken or marred material or products, replace them with new.
- C. On long-lead delivery items, which are damaged in shipping or storage, field repair may be authorized instead of replacement. Repair authorization must be in writing.

3.7 Field Quality Control

- A. Restoration of Finish: All marred or damaged surfaces, except exposed metal for grounding purposes, shall be refinished to leave a smooth, uniform finish at final inspection. Paint to match existing.
- B. Repair of Existing Work: Where cutting, channeling, or drilling of floors, walls, or other surfaces is necessary for the proper installation, support or anchorage of the conduit, raceways, or other electrical work, it shall be carefully done. The contractor shall repair with equal material by skilled workers, any damage to facilities caused by the contractor's workers or equipment. Prior FAA approval must be obtained for the materials, workers, time of day or night, repair method and for temporary or permanent repair purposes.
 - 1. On completion, repair work shall be inspected and accepted by the FAA with the concurrence of any other affected parties such as Utility Companies and Airport Authority.
- C. Damage: Where conduit and wiring to remain are inadvertently damaged or disturbed cut out and remove portion and all damaged wiring from the source panelboard, disconnect switch or pull box to the load/destination point. Provide new wiring and conduit of equal capacity.

End of Section

SECTION 16060 GROUNDING AND BONDING

PART 1 - GENERAL

1.1 Summary: This Section includes furnishing material, equipment and labor necessary to install a complete grounding system for the protection of life and equipment from lightning and power faults, and for minimizing electromagnetic interface. Grounding requirements specified in this Section may be supplemented by requirements in other Sections of these Specifications. Work shall include the following systems:

1. Power System Grounding
2. Electrical and Electronic Equipment Grounding
3. Raceway Grounding and Bonding
4. Multipoint Grounding

1.2 Reference Standards: Applicable only to the extent specified.

- A. American National Standards Institute (ANSI)
 1. C62.41 Recommended Practices on Surge Voltages in Low-Voltage AC Power Circuits
- B. American Society for Testing and Materials (ASTM)
 1. B3 Soft or Annealed Copper Wire
 2. B8 Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft
 3. B33 Tinned Soft or Annealed Copper Wire for Electrical Purposes.
- C. Federal Aviation Administration (FAA)
 1. C-1217f Electrical Work, Interior
 2. STD-012 Paint Systems for Equipment
 3. STD-019e Lightning and Surge Protection, Grounding, Bonding, and Shielding Requirements for Facilities and Electronic Equipment
- D. Institute of Electrical and Electronic Engineers (IEEE)
 1. 81 Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
 2. 1100 Powering and grounding sensitive electronic equipment
- E. National Fire Protection Association (NFPA)
 1. 70 National Electrical Code (NEC), latest edition
 2. 77 Static Electricity
 3. 780 Lightning Protection Code
- F. Occupational Safety and Health Administration (OSHA)
 1. 29CFR1910.7 Definitions and Requirements for Nationally Recognized Testing Laboratories (NRTL)
- G. Underwriters Laboratories (UL)
 1. 96 Lightning Protection Components
 2. 96A Installation Requirements for Lightning Protection Systems
 3. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors
 4. 467 Grounding and Bonding Equipment

1.3 Submittals

- A. Product Data for grounding rods, connectors and connection materials, and grounding fittings.
- B. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- C. Field tests and observation reports certified by the testing organization and indicating and interpreting the test reports for compliance with performance requirements.
- D. Surge and Transient Protection Requirements.

1.4 Quality Control

- A. Testing Agency Qualifications: An NRTL as defined in OSHA Regulation 1910.7, or a full member company of NETA.
 - 1. Testing Agency Field Supervision: Use persons currently certified by NETA or the National Institute for Certification in Engineering Technologies or the Bermuda equivalent to supervise on-site testing specified in Part 3.
- B. Comply with FAA specification C-1217f, FAA-STD-019e, FAA-STD-020b, and FAA Order No. 6950.20.
- C. Comply with NFPA 70, National Electrical Code, latest edition.
- D. Comply with UL 467.
- E. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - 2. Listing and labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.
 - 3. All lightning protection system equipment must be installed by a Master Label Certified Installer.

PART 2 - PRODUCTS

- 2.1 Grounding and Bonding Products: Of types indicated and of sizes and ratings to comply with FAA C-1217f and FAA-STD-019e, Where types, sizes, ratings and quantities indicated are in excess of requirements above, the more stringent requirements and the greater size, rating, and quantity indications shall govern.

2.2 Earth Electrode System (counterpoise)

- A. Grounding Electrode Conductor: The grounding electrode conductor shall be bare or insulated (not green) copper and shall be sized and indicated as shown on the contract documents.
- B. Ground Rods: Ground Rods shall be 3/4 inch diameter by 10 feet copper or copper-clad steel. Sectionalized type or exothermic butt welded rods shall be provided when deeper earth penetration is required. Ground rods shall bear the manufacturer's name, trademark and catalog number.
- C. Access Wells: Access wells shall be pre-cast concrete, and have a removable cover. The access well shall have a minimum interior measurement of 24 inches circular clearance, and be of sufficient size to allow ground rod connections to be readily accessible for testing

and maintenance. All connections shall be made by the exothermic weld process.

2.3 Wire and Cable Grounding Conductors

- A. Comply with Section 16120 "Wires and Cables": Properties," except as otherwise indicated on Contract Drawings.
 - 1. Material: Use only copper wire for both insulated and bare for grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials. Conductors shall conform to the following:
 - a. Solid Conductors: ASTM B3
 - b. Assembly of Stranded Conductors: ASTM B8
 - c. Tinned Conductors: ASTM B33
 - 2. Size: Bare ground conductors shall be sized in accordance with NEC and FAA STD 019e. Minimum allowable size of ground conductors in contact with earth shall be not less than #2 AWG.
- B. Equipment Grounding Conductors:
 - 1. Copper conductor with green color insulation.
Size: Equipment grounding conductors shall be sized the same as phase conductors unless otherwise permitted per FAA-STD-019e.
- C. Underground Conductors: Bare, tinned, stranded, except as otherwise indicated.

2.4 Miscellaneous Conductors

- A. Raceway Bonding Jumpers: Copper, minimum size #6 AWG above grade, #2 AWG below grade.
- B. Guard Cable: #1/0 AWG, 7 strand, bare copper cable.
- C. Counterpoise Cable: Minimum #4/0 AWG, 7 strand, bare copper cable.

2.5 Connector Products

Exothermic Welded Connections: Provided in kit form and selected per manufacturer's written instructions for specific types, sizes, and combinations of conductors and connected items. All underground conductor-to-conductor connections and conductor to ground rod connections shall be made by the exothermic weld process, unless otherwise noted. For certain materials and shapes which exothermic welds may not be possible, coordinate connection method with Resident Engineer (RE) Designee.

- 1. Substitutes: Provide exothermic connections equal to Cadweld. To substitute another exothermic weld process, the Contractor must submit a chemical analysis by an independent test laboratory certifying:
 - a. The material used contains no phosphorous, caustic, toxic or explosive substance.
 - b. Weld material used for ground connections contains copper oxide, aluminum and not less than 3% tin as a wetting agent. Weld metal for cathodic connections shall contain vanadium, but no tin.
 - c. A minimum of 80 percent of the weld metal shall screen out between 30 and 140 Mesh.
 - d. Exothermic Weld shall meet the applicable requirements of IEEE-80, Chapter 9, Section of Conductors and Joints.
 - e. Molds shall be made from graphite or other material withstanding welding temperatures and shall be designed to provide average life of not less than 50 exothermic welds under normal conditions. The molds shall bear permanent marking, indicating the name of the manufacturer., the mold model, the type, and size of the welding mixture compatible

with the welding process and the size of the conductor. Instructions detailing general safety information, welding procedures shall be provided with each mold. The installer is prohibited from using a mold from one manufacturer with a different manufacturer's welding mixture.

2. Application: Exothermic connections to be used outdoors shall be suitable for exposure to the elements and direct burial without degradation over the grounding system.

3. PART 3 - EXECUTION

3.1 Application

Grounding:

1. Installation of FAA grounding requirements often exceed those of NEC; therefore, grounding system shall be installed as indicated in Contract Drawings, and as specified herein. Reference IEEE-1100- 1992/2005, "Recommended Practice for Powering and Grounding Sensitive Electronic Equipment", when installing equipment. In no case shall the NEC be violated.
2. Under no circumstances shall the equipment grounding conductor be omitted from the electrical system, nor shall any separate grounding system such as electrical signal ground or direct connections to the Earth Electrode System be used for an alternate grounding system or an alternate path to the grounding electrode conductor.
3. All ground connections to equipment shall be made with a ground connector specifically intended for that purpose.
4. Equipment grounding conductor shall be connected to the grounded conductor (neutral) only at a separately derived systems, such as the service entrance or at system Delta-Wye transformer. This connection is identified as a Main Bonding Jumper for service entrance or a system bonding jumper for a Delta Wye transformer."

3.2 Installation:

- A. Install grounding systems in accordance with FAA C-1217f, FAA STD-019e, and local codes.
- B. Service Entrance Grounding: At the service entrance equipment, bond the service neutral, building neutral and building ground conductor to a common grounded (neutral) bus (or lug). Connect the grounded bus (or lug) to the counterpoise grounding system with the grounding electrode conductor. All connections at the service shall be made on grounded buses (or lugs). Split bolts or cable clamps are not allowed to for this connection.
- C. Grounding Electrode Conductor: This conductor shall be connected to the neutral bus in the service disconnecting means and shall extend directly to a ground rod and/or counterpoise in the grounding electrode system in one continuous unspliced run. The ground electrode conductor shall be insulated with bare copper and sized as shown in the Contract Drawings. When not indicated in the contract documents, the conductor shall be sized in accordance with NEC Table 250-66 "Grounding Electrode Conductor for AC Systems," except that the conductor shall not be smaller than #2 AWG per FAA STD 019e. All grounding electrode conductors, shall be routed in PVC conduit. The grounding electrode conductor shall be connected to the Earth Electrode System by exothermic means. Make connections readily accessible for inspection. For a separately derived system such as an isolation transformer, the ground electrode conductor shall be connected in accordance with the NEC.
- D. Grounded Conductor (Neutral): Shared/common neutrals (grounded conductor) shall not be permitted, i.e., each overcurrent protection device shall have its separate grounded conductor.

Grounded conductors shall be sized in accordance with NEC Article 210.4.

- E. Earth Electrode System (Counterpoise): Unless otherwise indicated on Contract Drawings, the grounding electrode system shall consist of a minimum of four (4) ground rods located at each corner of the structure.
1. Ground rods shall be interconnected by a buried, bare, #4/0 AWG, stranded copper cable. The ground cable shall be directly buried at least 2'-0" below grade level. The interconnecting cable shall close on itself, forming a complete loop, with the ends exothermically welded. Provide sufficient mechanical protection during installation so as not to break cable or connections.
 2. Connect structural steel of buildings the earth electrode system with a bare, #4/0 AWG cable.
 3. All underground metallic pipes, metallic conduit, tanks, and telephone ground shall be connected to the earth electrode system by a copper cable no smaller than #2 AWG. Exothermic welds shall not be used where hazards exist, i.e. near fuel tanks. In these cases, pressure connectors will be allowed as approved by RE Designee.
 4. All exposed non-current carrying metallic parts of electrical and mechanical equipment including metallic raceway systems, piping, steel columns and structural members and neutral conductors of the wiring systems shall be grounded as required by the NEC and FAA STD019e.
 5. Install ground cables in conduit where routed above grade, unless otherwise indicated on Contract Drawings.
 6. Guard Wire: Install guard wire in trench lines where protecting PVC or direct buried cables. Connect guard wire to ground rods and the earth electrode system by exothermic means. Space ground rods 90 feet nominal in trench lines. Locate ground rods 2 feet outside of trench/hand-hole wall.
 7. Ground pad-mounted equipment and non-current-carrying metal items by connecting them to Earth Electrode System by exothermic means.
 8. Ground Rods: Install ground rods as follows:
 - a. Spacing: Ground rods shall be as widely spaced as practical, and shall not be spaced less than one rod length apart. Spacing between rods around structures should be between 10 to 30 feet, nominal 20 feet, as shown on Contract Drawings.
 - b. Depth of rods: Tops of vertically-driven ground rods shall be not less than 12 inches below grade level.
 - c. Location: Ground rods shall be located 2 to 6 feet outside the foundation or exterior footing of the structure.
 - d. Manholes and hand-holes: Install driven ground rods 2 feet from outside wall of hand-hole/manhole. Install a #2 AWG bare conductor from ground rod in manhole/hand-hole through a waterproof sleeve in manhole/hand-hole wall, and exothermically weld to the ground rod. Install a copper ground bus in each hand-hole/manhole.
 9. Access Wells: Install where indicated on contract drawings. Set top of well flush with finished grade or floor. Place gravel in well to a level 3 inches below ground rod connections.
- F. Equipment Grounding Conductors: All metallic non-current carrying parts of electrical equipment shall be grounded with equipment grounding conductors whether or not shown on the drawings.
1. Size: Size equipment grounding conductors in accordance with Table 250-122 of the NEC, "Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment." Where ungrounded conductors are increased in size to compensate for voltage drop, the equipment grounding conductors shall be increased in size proportionately per the NEC. Minimum size shall be #12 AWG.
 2. Install equipment ground conductors in the same raceway as its related feeder and branch circuit conductors. Connect this conductor to the ground bus in the panelboard.
 3. Sharing of equipment ground conductors between circuits is not permitted. Each overcurrent

- protection device shall have its own separate equipment grounding conductor.
4. Metal conduit housing the equipment ground conductors shall be electrically continuous forming a parallel path to the equipment ground conductor.
 5. All connections to equipment to be grounded shall be made with a grounding connector specifically intended for that purpose.
 6. Bare wire wrapped around connecting screws or mounting bolts and screws, is not acceptable as a ground connection. All ground lugs shall be of a non-corrosive material suitable for use as a ground connection and must be compatible with the type of metal being grounded. Ground lugs shall be mounted on clean, bare metal surfaces that are free of paint, rust, etc.
 7. Conduit or cable shields shall not be used as the equipment ground conductor.
 8. All grounding conductors shall be terminated in their respective lug. One lug per conductor only.

G. Conduit: All metal conduit shall be grounded as follows:

1. All joints between conduit sections and between conduit, fittings and boxes shall be electrical continuous.
2. All pipe and lockout threads shall be treated with a conductive lubricant prior to assembly. Joints that are not otherwise electrically continuous shall be bonded with shirt jumpers of #12 AWG or larger copper wire. Refer to 19e for proper sizing.
3. The jumpers shall be welded or brazed in place or shall be attached with clamps, split bolts, grounding bushings or other devices approved for the purpose of grounding.
4. All bonds shall be protected against corrosion.
5. Cover plate of conduit fittings, pull boxes, junction boxes, and other outlet boxes shall be grounded by securely tightening all available screws.
6. Every component of metallic conduit runs shall as individual sections, couplings line fittings, pullboxes, junction boxes, and outlet boxes shall be bonded directly or indirectly to the ground system of facility steel.
7. Conduit brackets and hangers shall be securely bonded to the conduit and to the metal structure to which they are attached.

H. Equipment Enclosure Grounding: Ground all enclosures (panelboards, boxes, cabinets etc.) of electrical and electronic wiring distribution equipment with approved ground lugs in accordance with the NEC.

I. Sleeves: Where ground cables pass through slabs, buildings etc., and when not in metallic enclosures, provide a PVC conduit sleeve.

J. Electronic Multipoint Ground System: Insulated; color shall be green with bright orange tracer. Where cables are concealed and not color-coded, any exposed portion of the cable and each end of the cable for a minimum of 2 feet shall be color coded by green tape overlaid with bright orange tape to form the tracer. Where routed through raceways or wireways, the color-coding shall be such that by removing or opening any cover, color-coding shall be visible.

K. Fault Protection: Prevent equipment parts subject to human contact during installation from being electrically energized during powering faults or when components fail. Ground parts with a low impedance path to the chassis or cabinets in which they are mounted.

3.3 Connections:

A. Materials procured and installed in this Section shall be in accordance with FAA C-1217f, and FAA STD-019e.

- B. Make connections so that the possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to assure high conductivity and to make contact points closer in order of galvanic series:
 - a. Make connections with clean, bare metal at points of contact.
 - b. No dissimilar metal connections to conductor shall be approved or accepted.
 - c. Where exothermic welding cannot be used or is inappropriate, use FAA approved “U” type bronze pipe connections.
- C. Exothermic-Welded Connections: Used for connections to structural steel and for underground connections. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- D. Ground lugs and bushings: Terminate insulated equipment grounding conductors for feeders with pressure-type ground lugs. Where metallic raceways terminate at non-metallic or non-conductive housings, terminate each conduit with a ground bushing. Connect ground bushings with a bare ground conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare ground conductors.
- E. Other Grounding Systems: Not Used
- F. Connections at Access Wells: Use exothermic welded connections between conductors and grounding rods in access wells unless otherwise indicated on Contract Drawings.
- G. Torque: Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with torque tightening values specified in UL 486A.
- H. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Mechanical connections using a Burndy “Hyground Connector” or equipment when operated at a force of 24,000 pounds are acceptable as FAA approved pressure connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on ground conductor. Hydraulically crimped connectors are not acceptable in a lightning protection system.
- I. Lug Type Connections to Equipment: Use NEMA 2-hole ground lugs. Grounding lugs, connectors and other components shall comply with the NEC, latest edition.

3.4 Bonding Requirements

- A. Method: At each location where conduits first penetrate a shelter or building's exterior wall direct connections shall be made to the equipment ground.
- B. Bonding straps include jumpers, shall be installed in the following locations:
 - 1. Bonding straps shall be attached to the basic member.
 - 2. Bonding straps shall be installed to be unaffected electrically by motion or vibration.
 - 3. Bonding straps shall be installed whenever possible in areas accessible for maintenance.
 - 4. The method of installation and point of attachment of bonding straps shall not weaken the members to which they are connected.
- C. Bonding Straps: Bonding straps shall not be compression-fastened through non-metallic

material.

3.5 Field Quality Control

- A. Tests: Perform tests described below. Ensure no connection to utility power is made during testing.
 - 1. Fall of Potential: Subject the completed EES system to a earth resistance test using a ground test null balance megger instrument designed for the purpose, such as a Biddle, utilizing the fall of potential method (3-point). Measure ground resistance not less than 3 full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - a. Earth Electrode System Resistance: The resistance of the earth electrode system shall not exceed 10 Ohms unless otherwise noted.
 - 2. Bolting Resistance: Spot test to verify that ground cable bolted connections have a DC resistance of one milliohm maximum, when measured with a bridge type milliohmeter or similar instrument.
 - 3. Continuity: Test ground conductors, sheet metal, metallic conduits, cellular metal deck, equipment enclosure, metallic enclosures, and lighting fixtures for continuity to ground system with a meggar.
 - 4. Bonding Resistance: Unless otherwise specified all bonds shall exhibit a resistance of one milliohm or less when measured between bonded members with a 4 terminal milliohm meter.
 - 5. Witness: Tests shall be witnessed by RE and Local FAA.
- B. Deficiencies: Where ground resistances exceed specified values, tighten connections, modify the EES system by the addition of additional ground rods, or replace faulty wiring as required until continuity/resistance conforms to the NEC requirements and the requirements of this Specification. Re-measure the continuity/resistance to verify compliance. A written description of the test and readings shall be sent to the Engineer of Record.
- C. Report: Prepare test reports of continuity/resistance at each test location. Include observations of weather and other phenomena that may affect test results. Submit test reports to RE.

3.6 Earth Electrode System Resistance Test Procedure: A qualified electrician furnished by the contractor, shall perform the following test. The following procedure is the fall of potential method (three terminal test). Connections of ground test equipment to probes and EES is shown in Figure 16060-1.

- A. Sketch: Prepare a sketch utilizing template sketch of the EES and the contract drawings. Select a point on the EES and a direction of measurement which is away from the EES under test, and away from known underground metallic objects (water pipes, cables, etc.).
- B. Position the probe along a line which maximizes the distance from the EES under test and from other buried metals such as utility pipes, power and signal cables, fuel tanks, etc.
- C. NOTE: Readings obtained for the facility ground resistance are more accurate when the spacing between the probes. The distance chosen may be limited to the area available. Vary probe spacing to avoid paved areas.
- D. Measurements: Drive Probes 4" to 12" Deep into Earth at several points on a straight line between the measurement point and Probe. Measure the resistance in accordance with the instrument manufacturer's instructions. When performing these measurements the resistance read should increase to a certain point, level off, and increase again. A plot of Resistance to Earth vs. Distance may be drawn by using the values obtained as the probe is moved toward or

away from the outer probe. .

1. Repeat the above measurements in other directions at least 60 degrees from the first line of measurement and from other earth electrodes of the earth electrode system being checked. Whenever the test probe locations are moved to other areas, there may be a difference in soil conditions which will result in a change to the resistance values at each probe position and/or the derived plot obtained.

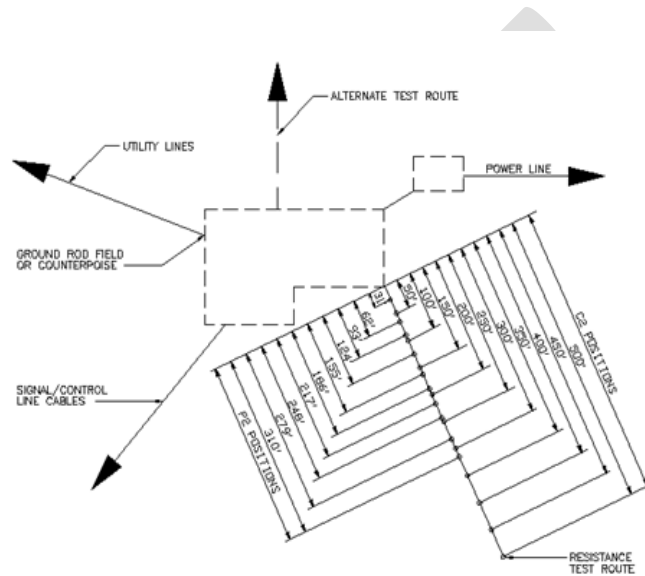
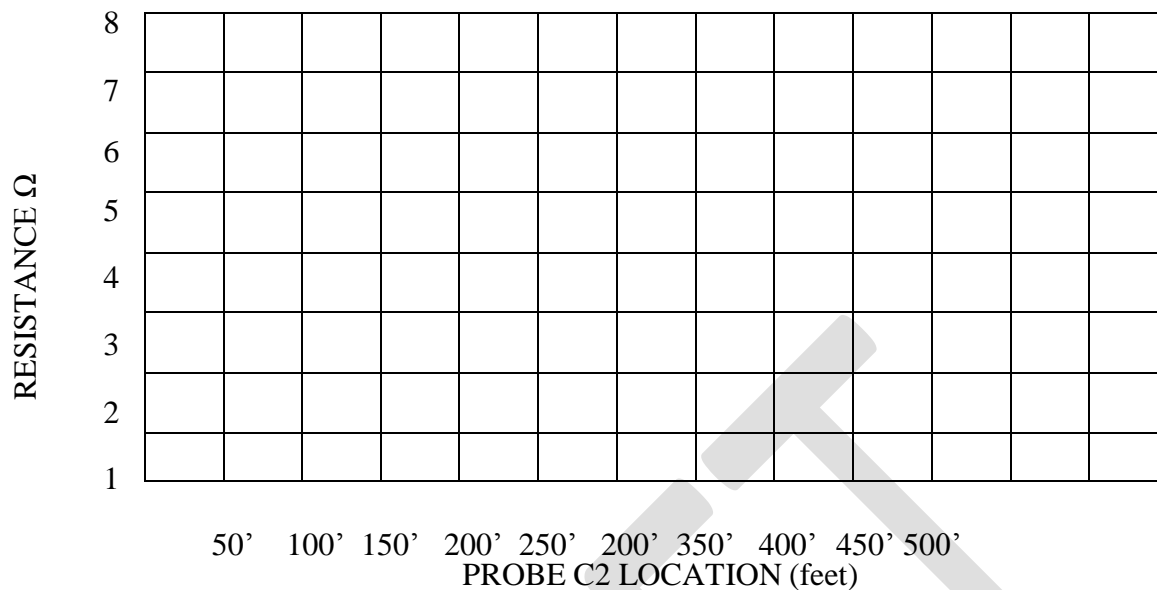


Figure 16060-2 Test Route (Sample)



EARTH RESISTANCE GRAPH (BLANK)

C2 PROBE DISTANCE	P2 PROBE DISTANCE (.62 x C2)	RESISTANCE METER READING
50		
100		
150		
200		
250		
300		
350		
400		
450		
500		

DEPTH OF REFERENCE PROBES=
 R_{Ω} (REFERENCE RESISTANCE) =

EARTH RESISTANCE DATA TABLE (BLANK)

FIGURE 16060-4 TEST METHOD B DATA TABLE AND GRAPH (BLANK)

- 3.7 Adjusting and Cleaning: Restore surface features, including vegetation, at areas disturbed by work of this Section. Reestablish original grades, except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying and other activities to their original condition in accordance with other sections of this specification. Maintain restored surfaces.

END OF SECTION

SECTION 16120

WIRES AND CABLES

PART 1 - GENERAL

1.1 Summary:

- A. This Section includes building wires and cables and associated splices, connectors, and terminations for wiring systems rated 600 volts and less.
- B. Work shall include:
 - 1. Wire
 - 2. Multi-Conductor Cable
 - 3. Wire Connections and Terminations
 - 4. Ground Wire

1.2 Reference Standards:

Applicable only to the extent specified.

- A. National Electrical Manufacturers Association (NEMA)
 - 1. WC70-00 Non-Shielded Power Cable 2000V or Less
 - 2. WC26-00 Binational Wire and Cable Packaging Standard
- B. Federal Aviation Administration (FAA)
 - 1. FAA-C-1391b Installation and Splicing of Underground Cables
 - 2. C-1217f Electrical Work, Interior
 - 3. STD-019e Lightning and Surge Protection, Grounding, Bonding, and Shielding Requirements for Facilities and Electronic Equipment
- C. Federal Specification (FS)
 - 1. W-S-610 Splice Connectors
 - 2. QQ-W-343 Wire, Electrical, Copper, Uninsulated
- D. National Electrical Contractors Association (NECA)
 - 1. 1-2000 Standard of Installation
- E. International Electrical Testing Association (NETA)
 - 1. ATS Acceptance Testing Specification for Electric Power Distribution Equipment and Systems
- F. National Fire Protection Association (NFPA)
 - 1. 70 National Electrical Code (NEC), latest edition
- G. Occupational Safety and Health Administration (OSHA)
 - 1. 29CFR1910.7 Definitions and Requirements for a Nationally Recognized Testing Laboratory
- H. Underwriters Laboratories (UL)
 - 1. 83 Thermoplastic-Insulated Wires and Cables
 - 2. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors

- I. American Society for Testing and Materials (ASTM)
 - 1. B3 Standard Specification for Soft or Annealed Copper Wire
 - 2. B8 Standard Specification for Concentric-Lay Standard Copper Hard, Medium Hard or Soft
 - 3. D753 Standard Specification for General Purpose Polychloroprene Wire and Cable
 - J. Institute of Electrical and Electronic Engineers (IEEE)
 - 1. 241 Recommended Practice for Electric Power Systems in Commercial Buildings
 - K. Insulated Cable Engineers Association (ICEA)
 - 1. S-95-658 Nonshielded 0-2kV Cables
 - 2. S-105-692 600V Single Layer Thermoset Insulated Utility Underground Distribution Cable
- 1.3 Submittals:
- A. Product Data: Submit product data for each product specified.
 - B. Specifications: Submit manufacturer's data on electric wire, cables, conductors, connectors, and connector crimping tools where specified.
 - C. Field Test Reports: Submit field test reports indicating and interpreting test results relative to compliance with the performance requirements of the testing standard.
- 1.4 Quality Control
- A. NFPA compliance: Comply with NFPA 70, NEC, latest edition, for components and installation.
 - B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed and Labeled": As defined in the NEC, Article 100.
 - 2. Listing and Labeling Agency Qualifications: An NRTL as defined in OSHA Regulation 1910.7.
 - C. Installer Qualifications: Cable splices shall be performed by experienced and qualified cable splicers. The workmen shall be licensed if required by the authority having jurisdiction.
- 1.5 Sequencing and Scheduling
- A. Coordination: Coordinate layout and installation of cable with other installations.
 - 1. Revise locations and elevations from those indicated as required to suit field conditions in coordination with the Work Release Project Engineer (WRPE) Designee.
- 1.6 Delivery, Storage, and Handling
- A. Delivery: Deliver all wire and cable products to the Project site in accordance with NEMA WC-26 and in their original packaging. Conductors with damaged insulation shall not be permitted.
 - B. Storage: Store wire and cable products in a clean dry space in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.

- C. Handling: Handle wire and cable products carefully to avoid abrading, puncturing, or tearing wire and cable insulation and sheathing. Ensure that the dielectric resistance integrity of wire/cable is maintained.

PART 2 – PRODUCTS

2.1 General:

- A. Materials procured in this Section shall be in accordance with FAA-C-1217f, FAA STD-019e, and FAA STD-020b.
- B. Unless otherwise indicated, wiring shall consist of 600 volt insulated, single conductor, copper conductor, installed in conduit. Conductor shall bear easily readable marking along the entire length, indicating conductor size and insulation type.

2.2 Wires and Cables

- A. Rating: Provide UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3, “Applications” of this section.
- B. Insulation – Above Grade and Interior Use: THHW/THWN conforming to NEMA WC70. XHHW conforming to NEMA WC70. Insulation for conductors in shall be per the NEC.
- C. Insulation – Below Grade Use: Conductors routed underground in conduit shall be type UF, XHHW, RHW, XLP, USE, or of a multiconductor armored construction with equivalent outer insulation. Conductors shall never be in contact with the earth. Service entrance lateral conductors shall be for service entrance.
- D. Characteristics:
 - 1. All wire, conduit sizes, and ampacities are based on copper conductors, 75 degrees C insulation.
 - 2. Conductivity shall not be less than 98 percent at 20 degrees C (68 degrees F) or resistivity greater than 1.7 microohms per centimeter.
 - 3. Provide solid conductors for #10 AWG and smaller, stranded conductors for larger than #10 AWG.
 - 4. Stranded conductors smaller than #10 AWG are allowed in applications where vibration and flexing may be encountered.
 - 5. All control wiring shall be stranded.
- E. Size:
 - 1. Minimum power conductor size shall be #12 AWG.
 - 2. Minimum conductor size shall be #10 AWG for 120 volt circuits where circuit length (one way) exceeds 75 feet from source, and #8 AWG for 120 volt circuits where circuit length (one way) exceeds 150 feet from source.
 - 3. Communication/control systems wiring size shall be in accordance with Manufacturer’s requirements.
 - 4. Minimum control wire size shall be #14 AWG unless otherwise noted.
- F. Color Code: Conductors smaller than #4 shall be factory color coded. Color coding shall be continuous throughout the facility on each phase conductor to its point of utilization so that the conductor phase connection is readily identifiable. If there is no standard color coding at the facility, conductors shall be color coded as follows:
 - 1. AC power wiring

Three Phase

Single Phase

120/208 Volt System

- a) Line 1 Black
- b) Line 2 Red
- c) Neutral White

120/240 Volt System

- a) Line 1 Black
- b) Line 2 Red
- c) Neutral White

2. Equipment Grounding Conductor: Green (for all systems)

3. Control Wiring

- a. Ungrounded conductor wiring Violet
- b. Grounded conductor wiring White

4. Control Cables shall be color coded in accordance with IAW NEMA WC70.

G. Uninsulated Conductors: For uninsulated conductors refer to Section 16060, "Grounding and Bonding."

H. Prohibited Wire Products: The use of non-metallic sheathed cable types NM to NMC, armored- bushed cable (BX), and armor-clad cable (AC) is prohibited.

I. Control Cable:

- 1. Contractor-furnished control cable shall be in accordance with Section 3.1.2 of FAA- C-1391b, and with Rural Utilities Service 7 CFR 1755.390 (REA PE-39). This cable shall have a core consisting of 19 gauge size (AWG) solid copper conductors with thermoplastic or thermosetting insulation color-coded per telephone industry standards. The core shall be completely filled with ETPR compound. The outer sheath shall have a corrugated copper shield applied longitudinally around core. The outside jacket shall be black polyethylene. It shall be a standard product of a major cable manufacturer, and shall be rated for outdoor, direct-earth burial use.

J. HELIAX Coaxial Cables

- 1. Coaxial cable shall be Heliac foam dielectric cable manufactured by Andrew Corp, Orland Park, Illinois 708-349-3300.
- 2. 1/4 inch coaxial Heliac cable shall be Andrew product number LDF1 – 50A. This is a low-loss foam-dielectric, Heliac coaxial cable.
- 3. Due to its reliable history in FAA Southern Region compared with other products with similar characteristics, and its compatibility with cable connectors used by the FAA, no substitutions of another brand will be allowed for Heliac cable.

2.3 Connectors and Splices

A. Connectors: Provide UL-listed factory-fabricated wiring connectors of size, ampacity and temperature rating, material, type and class required by NFPA and NEMA standards for application and for services indicated. Select connectors to comply with the project's installation requirements and as specified in Part 3, "Applications."

- 1. For conductor sizes #10 AWG and smaller, provide 600V solder-less, insulated pressure cable connectors, of the compression or indent type, or wire nut connectors.
- 2. For cable sizes #8 AWG and larger provide long barrel type compression connectors.
- 3. Stranded conductors may be used with wire compression connectors or a pressure

washer type lug.

B. Splices:

1. Splice Envelopes:

Power cables 600 volts and below: No splices shall be accepted.

b. Control and telephone cables: Re-enterable filled splice envelope, Scotch brand 3925 or approved equal.

2. Splice Material: Provide all insulating materials for splices and connections such as glass and synthetic tapes, putties, resins, splice cases or compositions of the type approved for the particular use, location, voltage and temperature and apply and install in an approved manner, all in accordance with the manufacturer's recommendations.

4. Insulating Tape: Provide plastic electrical insulating tape that is flame retardant and cold weather resistant. Tape to be used in areas that are subject to 30 degrees C to 105 degrees C, or where the tape will be subjected to an oil splash, shall have a minimum thickness of 8.5 mils, and shall consist of an oil-resistant vinyl backing with an oil-resistant acrylic adhesive.

C. Underground Taps: Waterproof and rated for application.

PART 3 - EXECUTION

3.1 Examination: Examine raceways that are to receive wires and cables for compliance with installation tolerances and other conditions. Verify that the duct or conduit is open, continuous, and clear of debris before installing cable. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 Applications

A. Grounded Conductors: In single-phase systems (120 volt two-wire and 120/240 volt three-wire), one grounded conductor (neutral) shall accompany each ungrounded phase conductor (120 volt systems) or ungrounded phase conductor pair (120/240 volt systems) powered from a circuit-interrupting device. In three-phase (Y-connected, 4-wire) systems, one grounded neutral conductor shall accompany the three related ungrounded conductors fed from a circuit interrupting device. All neutral conductors shall extend from the neutral bus in the power source. Device terminals for connection of more than one conductor shall be specifically designed for that purpose.

B. Bundling: Neatly and securely bundle all conductors #10 AWG and smaller located in branch circuit panelboards. Neatly secure cable in individual circuits for all conductors larger than #10 AWG located in pull boxes. Bundle cable with wire ties.

3.3 Installation

A. Conductors and Cables:

1. Materials installed in this Section shall be in accordance with FAA-C-1217f and FAA STD-019e.

2. Install wires and cables as indicated, according to manufacturer's written instructions and the NECA "Standard of Installation." Tag all conductors at their termination in accordance with Section 16195, "Electrical Identification."

3. Pull conductors into raceway simultaneously when more than one is being installed in the same raceway.
 - a. Use wire pulling compound or lubricant as required. Compound used must not deteriorate the conductor or insulation, and must be non-flammable.
 - b. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage the cables or raceway.
 4. Cable shall be installed in a manner to prevent harmful stretching of the conductor, injury to the insulation, or damage to the outer protective covering.
 5. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.
 6. The ends of cables shall be sealed with moisture-seal tape before pulling, and shall be left sealed until connections are made.
- B. Conductor Splices:
1. Splices shall be made at outlets, junction boxes, pull boxes, or accessible raceways only.
 2. Splices shall be made with solderless connectors conforming to FS W-S-610, UL-486A, UL-486C, and UL-486E.
 3. Wire nuts may only be used to splice conductors sized #10 AWG and smaller.
 4. Compression connectors shall be used to splice conductors #8 AWG and larger. Use proper tool to provide circumferential pressure connection.
 5. All splices, including those made with insulated wire nuts, shall be insulated with electrical tape or heat-shrink tubing to a level equal to that of the factory insulated conductors.
 6. Splicing of ungrounded conductors in panel boards is not permitted.
 7. Install splices and insulating tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
 8. Use splice and tap connectors that are compatible with conductor material.
 9. Splicing methods and material shall be of a type recommended by the manufacturer of the splicing material for the particular type of cable being spliced, and shall be approved by the WRPE Designee prior to installation.
 10. Conductors of different color insulation shall never be spliced together.
 11. Keep conductor splices to a minimum.
 12. Splice 600V conductors in pull boxes only.
 13. A splice shall not be pulled into a duct or a conduit under any circumstances.
 14. Install waterproof taps in underground structures.
- C. Conductor Identification: For conductors #4 AWG and larger, color code in accordance with this Section and Section 16195, "Electrical Identification."
1. All line, phase, and neutral conductors shall have their source and circuit labeled.
 2. Conductor identification shall be provided at all terminations, in all junction boxes through which these conductors pass, and within each enclosure where a splice, tap, or termination is made.
 3. Terminal and conductor identification shall match at both ends of the run, as on approved shop drawings.
- D. Wiring at Outlets: Install with at least 12 inches of slack conductor at each outlet for connection to equipment. Identify all conductor circuit numbers at terminals and junction points.
- E. Connections at Outlets: Connect outlets and components to wiring and to ground as indicated on shop drawings. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard

486A.

- F. Large Conductors: Cables/conductors sizes 250 kcmil and greater shall be installed with the use of a hydraulic cable bender where installed exposed (e.g. manholes). Cable supports shall be required for stress relief.
- G. Grounding: Grounding shall be installed in accordance with section 16060, "Grounding and Bonding."
- H. Shared Neutrals and Grounds: Separate neutral and ground wires shall be provided for each overcurrent protection device. Shared/common neutrals are not allowed. Install a separate neutral wire per phase for all lighting and power outlet circuits.
- I. Termination: Provide compression type termination lugs where mechanical lugs included with equipment do not comply with FAA STD-1217f, Paragraph 4.6.5.2.
- J. Phasing: The phasing of the complete electrical installation shall be connected and consistently maintained throughout the power distribution system. The phasing shall be A, B, C, in the clockwise direction.
- K. Conductor Supports: The contractor shall provide conductor supports as required by the NEC and recommended by the cable manufacturer. Where required, route vertical conductor runs in conduit.
- L. Conductors and Slack: Provide all conductors and connectors necessary for a complete installation from the point of service connections to all devices shown on the drawings, in schedules, and in the specifications. Provide ample slack wire for all connections.

3.4 Field Quality Control

- A. Testing, General: Cables shall be tested prior to installation and again upon completion of the installation. Testing shall also be performed prior to termination. Tests shall be performed in the presence of the WRPE Designee.
 - 1. Upon installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Standard ATS, Section 7.3.1. Certify compliance with test parameters.
 - 3. Test wire and cable for continuity of circuitry, proper phasing, and also for short circuits.
- B. Insulation Resistance Tests: Feeder and Branch Circuit insulation tests shall be performed after installation, but before connection to equipment.
 - 1. Conductors shall test free from short circuits and grounds, and have a minimum phase-to-phase and phase-to-ground insulation resistance of 30 megohms when measured with a 500-volt DC insulation resistance tester. The contractor shall submit a letter type test report to the RE Designee prior to final inspection of the Work. The report shall list the tests performed and results obtained.
 - 2. Always disconnect all SPDs prior to using a megger on the system.
 - 3. Apply the test voltage for at least one minute after motor reading has stabilized.
 - 4. Contractor shall use "FAA megger form" located at the end of this Section to record megger readings.
- C. Corrections: Correct malfunctioning products at site, where possible, and retest to

demonstrate compliance; otherwise, remove and replace with new units, and retest.

DRAFT

FAA MEGGAR FORM
Field Test Record Meggar Readings
(Power and Control Wire/Cable)

Project _____
 Name _____
 Project No. _____

Date _____ Sheet No. ____ of ____
 Address _____

NOTE: MEGGAR ALL PHASES, RECORD MINIMUM READING.

Panel No. Ckt. No. Feeder No.	WIRE TAGGING	VOLT.	WIRE OR CABLE				MEGOHMS	SUPERVISOR O.K.
			NO.	SIZE	FROM	TO		

DISTRIBUTION: WRPE Designee
 CONTRACTOR
 RE
 File

 RE Designee / Date

 Contractor Supervisor / Date

END OF SECTION

SECTION 16130

RACEWAYS, FITTINGS, BOXES, AND CABINETS

PART 1 - GENERAL

1.1 Summary

- A. This Section includes furnishing material, equipment, labor and incidentals necessary to install a complete and operational system of raceways, fittings, boxes, enclosures, and cabinets for each type of electrical system.
- B. Types of raceways in this Division include the following:
 - 1. PVC coated rigid steel.
 - 2. Polyvinyl chloride conduit (PVC).
 - 3. Rigid steel (metal) conduit, zinc coated (RGS or RSC).
 - 4. Electrical metallic tubing (EMT).
 - 5. Liquidtight flexible metal conduit.
- C. Types of boxes, enclosures, and cabinets in this Division include the following:
 - 1. Outlet boxes.
 - 2. Pull and junction boxes.
 - 3. Cabinets and enclosures with hinged covers.

1.2 Reference Standards: The current issues of the following documents in effect on the date of the Request- For-Offers from part of this Specification and are applicable to the extent specified herein:

- A. American National Standards Institute (ANSI)
 - 1. C80.1 Rigid Steel Conduit, Zinc-Coated RGS.
 - 2. C80.3 Electrical Metallic Tubing, Zinc-Coated (EMT).
 - 3. C80.6 Intermediate Metal Conduit (IMC) Zinc-Coated
 - 4. 870 Wireways, Auxiliary Gutters and Associated Fittings
- B. Federal Aviation Administration (FAA)
 - 1. STD 019e Lightning Protection, Grounding, Bonding and Shielding Requirements Facilities.
 - 2. STD 020b Transient Protection, Grounding and Shielding Requirements for Equipment.
 - 3. C-1217f Electrical Work, Interior.
- C. Federal Specifications (FS)
 - 1. W-C-586 Conduit Outlet Boxes, Bodies, and Entrance Caps.
- D. National Electrical Contractors Association (NECA)
- E. National Electrical Manufacturers Association (NEMA)
 - 1. FB1 Fitting, Cast Metal Boxes, and Conduit Bodies, and Cable Assemblies
 - 2. OS1 Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
 - 4. 250 Enclosures for Electrical Equipment (1000 Volts and Below)
 - 5. ICS-6 Industrial Control System Enclosure.
 - 6. RN1 Polyvinyl Chloride (PVC) Externally Coated Galvanized Conduit.

- F. National Fire Protection Association (NFPA)
 - 1. 70 National Electrical Code (NEC), latest edition
 - G. Occupational Safety and Health Administration (OSHA)
 - 1. 29CFR1910.7 Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL)
 - H. Underwriters Laboratories (UL). Materials having UL listing shall bear the UL label.
 - 1. 6 Rigid Metal Conduit
 - 2. 50 Enclosures for Electrical Equipment
 - 3. 360 Liquid-tight Flexible Metal Conduit
 - 4. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors
 - 5. 514A Metallic Outlet Boxes
 - 6. 514 B Fittings for Conduit and Outlet Boxes
 - 7. 797 Electric Metallic Tubing
 - 8. 870 Wireways, Auxiliary Gutter, and Associated Fittings.
 - 9. 1242 Intermediate Metal Conduits
 - 10. 651 PVC Conduit
 - I. Steel Structures Painting Council (SSPC)
 - 1. PS-10.01 Hot-applied coal tar enamel painting system.
- 1.3 Submittals: Submit manufacturer's product data for all raceway and fittings, floor boxes, hinged cover enclosures, and cabinets. Include specifications, installation instructions and general recommendations. For nonstandard boxes, enclosures, cabinets, or routing: Include layout drawings showing components, wiring, supports, and seismic bracing.
- A. Boxes shall be provided in the wiring and raceway system for pulling wires, making connections.
- 1.4 Quality Control
- A. Comply with latest edition of the NFPA 70 "National Electrical Code" latest edition for components and installation.
 - 1. Boxes shall be sized in accordance with NEC Article 370.
 - B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.

2. Listing and Labeling Agency Qualifications: An NRTL as defined in OSHA Regulation 1910.7.
 - C. Comply with NECA "Standard of Installation."
 - D. Coordinate layout and installation of raceway and boxes with other construction elements to ensure adequate headroom, working clearance, and access. All exterior enclosures shall be rated 4x.
- 1.5 Shop Drawings: Submit dimensioned drawings of raceway and wireway systems showing layout of raceway at all congested areas such as above and below panelboards.

PART 2 - PRODUCTS

2.1 General:

- A. Enclosures shall conform to NEMA standards.
- B. All materials procured under this specification shall be in accordance with FAA C-1217f, FAA STD-019e and FAA STD-020b.
- C. Raceway size:
Raceways shall be adequately sized to include the phase conductors, an equipment ground conductor (green) and a neutral conductor (gray or white) in accordance with percentage fill requirements by NFPA 70 (NEC) latest edition. Note: Per FAA-STD-019e, equipment grounding conductors are sized the same as phase conductors, impacting raceway size.
 1. Provide 3/4 inch conduit minimum unless otherwise indicated on Contract Drawings.

2.2 Conduit and Tubing

- A. Rigid Steel Conduit: Heavy wall mild steel tube with metallic corrosion resistant coating on exterior and interior, hot dipped galvanized steel, free from defects; Manufactured in accordance with Federal Specification W-C-581, ANSI C80.1 and UL 6.
- B. PVC Coated Steel Conduit: Meeting the requirements of Rigid Steel Conduits; 40mil PVC exterior coating and red urethane interior coating, in accordance with NEMA RN 1.
- C. Electrical Metallic Tubing: Welded steel tubing, formed of low carbon steel, electro-galvanized exterior, inside coated with a baked, elastic low-friction coating of enamel, in accordance with Fed. Spec. WW-C-563, ANSI C80.3 and UL 797.
- D. Liquidtight Flexible Metal Conduit; Flexible steel conduit with PVC jacket: Liquidtight conduit shall have an extruded, polyvinyl jacket over the flexible metal in accordance with UL 360 a. Flexible non-metallic conduit shall not be used.
- E. Rigid Non-Metallic Conduit (PVC): Schedule 80 high impact, polyvinyl chloride, in accordance with Federal Specification W-C-1094 and UL 651 listed.

2.3 Raceway Fittings, Couplings and Connectors

- A. Material: Use fittings listed and approved for specific conduit or raceway system used.
- B. Bushings and connectors: Bushings and connectors shall be insulated type which maintain continuity of conduit ground system. Insulating material shall be molded or locked into metallic body of the fitting. Bushing made entirely of nonmetallic material will not be allowed.
- C. Fittings and Conduit Bodies: UL 514B and NEMA FB 1, compatible with conduit and of the threaded type.
 - 1. Rigid Steel Conduit: Threaded type material to match the conduit, in accordance ANSI/NEMA FB1.
 - 2. Rigid Non-Metallic Conduit: Solvent-welded, slip-on joints.
 - 3. Below Grade Installations: For installation below slab, on-grade, or underground, the conduit shall be factory coated with either 0.008 inch of epoxy, 0.020 inch of polyvinyl chloride or 0.063 inch of coal-tar enamel or shall be field wrapped with 0.01 inch thick pipe wrapping plastic tape applied with 50% overlap.
 - 4. Electrical Metallic Tubing: Fittings used with EMT shall be compression-type fittings designed for this type of conduit, unless otherwise indicated. Screw-type fittings are not acceptable. Connectors shall have insulated-throat, smooth bell shaped end or a bushing.
 - 5. Set Screw fittings are not allowed.
 - 6. Elbows and Bends: Rigid and nonmetallic conduit system shall use factory elbows and bends for conduits 2 inches and larger for all bends greater than 45 degrees. Other conduit systems shall use the same material as the conduit with which they are installed. Underground concrete encased duct bank may use PVC for conduit runs and rigid for all elbows, transition to rigid 5'-0" before stubbing up.
 - 7. Bushings: High impact, thermosetting, phenolic insulation, 150 degrees C.
 - 8. Ground Bushing: Shall consist of a malleable iron, insulated throat conduit bushing with an attached setscrew lug.
 - 9. Locknuts: Zinc-plated or Cadmium-plated, malleable iron.
 - 10. Threaded Nipples: Conduit nipples shall have two independent sets of thread. Hubs: Cadmium-plated, malleable iron with tapered threads and neoprene "O" ring.
- D. Liquid-tight Flexible Metal Conduit Fittings: Liquid-tight flexible metal conduit fittings shall be made of galvanized steel. They shall be insulated and one of the following types:
 - 1. Wedge and screw type having an angular wedge fitting between the convolutions of the conduit.
 - 2. Squeeze or clamp type having a bearing surface contoured to wrap around the conduit and clamped by one or more screws.
 - 3. Steel, multiple point type, for threading into the internal wall of the conduit convolutions. E. Inferior material such as "pot metal" shall not be used for any type of fitting.
- F. All locknuts shall be of the bonding type with sharp edges for digging into the metal wall of the enclosure.

2.4 Outlet Boxes

- A. Sheet Metal Boxes: NEMA OS 1 and UL 514A; Galvanized steel with 1/2 inch male fixture studs where required.
- B. Cast Metal Boxes: NEMA FB 1, type FD, cast alloy box with gasketed cover, threaded hubs. Use cast boxes for damp and outdoor locations.

B. Fittings: UL 514B

2.5 Pull and Junction Boxes:

A. Small Sheet Metal Boxes: NEMA OS 1 and UL 514A.

B. Cast Metal Boxes:

1. Threaded-hub type conforming to UL 514A and UL 514B.
2. Galvanized steel conforming to UL 514A and UL 514BB

C. Covers: Class 30B gray cast iron conforming to ASTM-8, machine finished with flat bearing surfaces.

2.6 Interior/Exterior Cabinets and Enclosures

A. Hinged Cover Enclosures: NEMA 250, steel enclosure with continuous hinge cover and flush latch. Finish inside and out with manufacturer's standard enamel.

B. Cabinets and enclosures: NEMA 250, code gauge galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

1. Cabinets and enclosures shall be constructed with interior dimensions not less than those indicated on the Contract Drawings.
2. Provide 5/8 inch plywood backboard unless otherwise indicated.
3. Key latch to match panelboards. Provide two keys with each cabinet unless otherwise notified.
4. Interior cabinets and enclosures shall be rated NEMA 1.
5. Exterior cabinets and enclosures for power equipment shall be rated NEMA 3R.
6. Exterior cabinets and enclosures for splice/communication/control shall be rated NEMA 4X (fiberglass).

C. Safety: UL 50

D. Locks: All locks in this project shall be keyed alike.

PART 3 - EXECUTION

3.1 Preparation

A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of the raceway system. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine raceways prior to installation. No crushed or deformed raceway shall be installed.

C. Provide electrical boxes in locations shown on the plans and as required for splices taps, wire pulling equipment connections and code compliance.

3.2 Wiring Methods

- A. Outdoors: Use the following wiring methods:
 - 1. Underground Encased Concrete Ductbank: Rigid galvanized steel conduit and fittings.
 - 2. Exposed: Rigid steel conduit, unless otherwise indicated on Contract Drawings.
 - 3. Underground, Single or Grouped Run: Rigid steel/PVC conduit and fittings as Contract Drawings.
 - 5. Connection to Vibrating Equipment (including transformers) liquid-tight conduit.
 - 6. Boxes and Enclosures: NEMA Type 3R and/or Type 4X, as specified in Part 2.
- B. Indoors: Use the following wiring methods:
 - 1. Connection to Vibrating Equipment: Flexible metal conduit, except in wet or damp locations, use liquid-tight flexible metal conduit.
 - 2. Damp or Wet Locations: Rigid steel conduit.
 - 3. Exposed: Rigid steel conduit. PVC coated rigid steel conduit shall be used in the electrical/mechanical rooms to a height of 8 feet above finished floor.
 - 4. Boxes and Enclosures: NEMA Type 1.
- C. Conduit Use:
 - 1. Install rigid steel conduit (RSC) for all distribution panel feeders, transformer feeders.
 - 2. Use rigid steel or PVC conduit and fittings for underground concrete encased ductbanks as indicated on Contract Drawings, except the last 10'-0" entering a handhole or building shall be concrete encased RGS.
 - 3. Use PVC coated rigid galvanized steel conduit and fittings for all conduit systems installed in contact with earth.
 - 4. Ends of conduit systems not terminated in boxes or cabinets shall be capped.
 - 5. Where conduits enter enclosures without hubs, an appropriate connector with threads and locknuts shall be used to securely bond the conduit to the enclosure.
 - 6. The connector body and locknut shall be installed so that firm contact is made on each side of the enclosure. In addition, the connector shall be the insulated-throat type.
 - 7. EMT may be used only in dry interior locations, and where not subject to physical damage.
 - 8. EMT shall not be used on circuits above 600 volts or in sizes greater than 4 inches in diameter.
 - 9. EMT shall be used above grade in conjunction with frangible fittings as indicated on Contract Drawings.

3.3 Installation:

- A. Products shall be installed in accordance with FAA C-1217f, FAA STD-019e, and FAA STD-020b.
- B. Conduit:
 - 1. Minimum size for conduit power circuits shall be 3/4 inch, unless otherwise noted.
 - 2. Conduit for telephone and signal systems shall be as follows:
 - a. 1/2-inch conduit may be used for lengths not exceeding 50 feet. 3/4-inch conduit may be used for lengths not exceeding 100 feet.
 - b. 1-inch conduit shall be used for lengths exceeding 100 feet.
 - 3. No run shall contain more than four (4) 90-degree bends, or the equivalent between boxes.
Provide pull and junction boxes required to meet this criteria.
 - 4. Size conduits as required by the NEC for the number and sizes of wires to be pulled

into the conduit.

5. Use conduit bodies to make sharp changes in directions around ground beams.
 6. Use temporary closures/caps to prevent foreign matter and moisture from entering conduit.
 7. Use conduit fittings suitable for use and location.
 8. Conduit under/embedded in slabs: Install in middle third of the slab thickness where practical, and leave at least 1 inch concrete cover.
 - a. Secure conduit to reinforcing rods to prevent sagging or shifting during concrete placement.
 - b. Space conduit laterally to prevent voids in the concrete.
 - c. Run conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement. When at right angles to reinforcement, place conduit close to slab support.
 9. For installation below slab, on-grade, or underground, the Rigid Steel Conduit shall be PVC coated, 0.063 inch of coal-tar enamel.
 10. Field Cut Conduit: Where conduit has to be cut in the field, it shall be cut square using a hand or power hacksaw or approved pipe cutter using cutting knives. The cut ends of the field-cut conduit shall be reamed to remove burrs and sharp edges.
 11. Field Threaded Conduit: Where threads have to be cut on conduit, the threads shall have the same effective length and shall have the same thread dimension and taper as specified for factory-cut threads on conduit.
 12. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, or where conduits enter enclosures without threaded hubs, use two locknuts, one inside and one outside the box to securely bond the conduit to the enclosure.
 - a. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
 13. Bushings: Install a bushing on the interior threaded end of each conduit to protect conductor insulation.
 14. Make bends and offsets so the inside diameter is not reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel. Where space conditions prohibit the use of standard elbows, use ferrous alloy fittings to, match the conduit construction. "Condulet" type fittings shall not be used on conduits containing # 4 AWG or larger wire.
 - a. Bends in conduit that is 1 inch and larger shall have a minimum inside radii 12 times the nominal conduit diameter.
 15. Frangible Couplings: The point of frangibility shall be located no higher than 3-inches above grade when installed.
- C. Complete raceway installation before starting conductor installation. Inside of raceways shall be reamed, deburred, fished and swabbed before conductors are pulled.
- D. Support: Support raceways, boxes, cabinets and enclosures in accordance with Section 16190 "Supporting Devices."
- E. Floor and Wall Penetrations:
1. Penetrations through walls or floors separating the building interior from the exterior shall be sealed to prevent moisture and rodent entry and to deter air transfer.

2. Seal penetrations of walls which separate individually temperature or humidity controlled areas, to prevent air circulation.
 3. Conduit sealing methods and sealants shall be in accordance with the NEC.
 4. Conceal conduit unless otherwise indicated, within finished walls and ceilings.
- F. Exposed Raceways: Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
1. Run parallel or banked raceways together, and on common supports where practical.
 2. Make bends in parallel or banked runs from same center line to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways.
 3. Install raceways at proper elevations. Provide adequate headroom.
- G. Joints: Join raceways with fittings designed and approved for the purpose and make joints tight.
1. Use bonding locknuts and bushings at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
 2. Use insulating bushings for all conduits to protect conductors.
- H. Pull Wire: Install pull wires in empty raceways. Use #14 AWG zinc-coated steel or monofilament plastic line having not less than 200-LB tensile strength. Leave not less than 24 inches of slack at each end of the pull wire.
- I. Stub-Up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit. Flexible conduit may be used 6 inches above the floor/pad in coordination with Work Release Project Engineer (WRPE). Where equipment connections are not made under this Contract, install screwdriver-operated threaded flush plugs flush with floor. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- J. Flexible Connections:
1. Flexible, liquid tight metal conduit:
 - a. Use maximum of 6 feet of flexible conduit for equipment subject to vibration, noise transmission, or movement; in wet or damp outdoor locations; and for all motors.
 - b. May be used for branch circuits in lengths longer than 6 feet in computer room locations which meet requirements of NEC Article 645.
 - c. Fittings and junction boxes shall be liquid tight under raised floors.
 2. A separate ground conductor shall be provided across all flexible conduit in addition to the equipment ground conductor run in the conduit with its related power conductors. This conductor shall be bonded to the connecting device at each end of the flexible conduit.
- N. Boxes:
1. Shall be provided in the wiring or raceway system for pulling wires, making connections, and mounting devices and fixtures. Each box shall have the volume required by the NFPA 70 for the number and size of conductors in the box.
 - a. Pull/Junction Boxes: Installation shall be plumb and level. Bring pull boxes tops flush with finished grade. Install type suitable for location (interior/exterior,

dry/damp/wet).

- b. Outlet Boxes: Each outlet box shall have a machine screw which fits into a tapered hole into the box for the ground connection
 - c. Wet locations: Cast metal boxes installed in wet locations and boxes installed flush with exterior surfaces shall be gasketed.
 - d. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
 - j. Support boxes in accordance with Section 16190 "Supporting Devices." Minimum support shall be at each corner.
 - k. EMT entering an enclosure without threaded hubs: Provide a connector with threads and cast or machine lockout. The connector body and locknut shall be installed so that firm contact is made on each side of the enclosure.
 - l. Ends of conduit not terminated in boxes or cabinets shall be capped to protect against entry of dirt and moisture.
 - m. Locate and install boxes to allow access. Where installation is inaccessible, coordinate locations and sizes of required access doors in accordance with other sections of the specification.
2. Contractor shall coordinate with other trades and shall determine proper placement and mounting heights of all devices.

3.4 Grounding: Install grounding connections for raceway, boxes, and components in accordance with Section 16060.

3.5 Protection

Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to paint finishes with matching manufacturer recommended touch-up coating .
3. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at substantial completion. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer. Repair damage to PVC or paint finishes with matching touch-up coating recommended by the manufacturer. Cap stubbed up raceways, including raceways in cabinets, immediately upon installation. The use of paper or rag wads is not acceptable.
4. Galvanic Corrosion Protection: Avoid dissimilar metals in contact anywhere in conduit runs. Where contact cannot be avoided at conduit terminations, treat the connection with joint compound that eliminates galvanic corrosion. Where dissimilar metals are in contact, such as at aluminum cable tray or enclosures and steel supports, separate contact surfaces by using gaskets, non-absorptive tape or coating to prevent galvanic corrosion.

3.5 Fire Stopping

1. Apply fire stopping to all electrical penetrations of fire rated floor and wall assemblies to restore original fire resistance rating of assembly, min of 2 hour rating.

- A. Upon completion of installation of system, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions and cover raceways and boxes to prevent entrance of foreign matter, paint, etc.
- B. Remove dirt and construction debris from outlet, junction, and pull boxes, and cabinets. C. Deformed raceways, boxes, cabinets and enclosures shall be replaced.
- D. Run a swab or mandrel to remove dirt or blockages from raceways.

END OF SECTION

SECTION 16190

SUPPORTING DEVICES

PART 1 – GENERAL

1.1 Summary

- A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.
- B. Types of supports, anchors, sleeves, seals and fastenings specified in this Section include the following:
 - 1. Clevis hangers
 - 2. C-Clamps
 - 3. Toggle bolts
 - 4. One-hole conduit straps
 - 5. Two-hole conduit straps
 - 6. Wall and floor seals

1.2 Reference Standards

Applicable only to the extent specified.

- A. Federal Aviation Administration (FAA)
 - 1. C-1217f Electrical Work, Interior
 - 2. STD-019e Lightning and Surge Protection, Grounding, Bonding and Requirements for Facilities and Electronic Equipment.
 - 3. STD-020b Transient Protection, Grounding, Bonding, and Shielding Electronic Equipment.
- B. National Fire Protection Association (NFPA)
 - 1. 70 National Electrical Code (NEC), latest edition
- C. American Standard for Testing and Materials (ASTM)
 - 1. A1011 SS GR 33 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

1.3 Submittals: Product data for each type of product specified.

1.4 Quality Control

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70, (NEC) latest edition.
- B. Electrical components shall be listed and labeled by UL or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

PART 2 – PRODUCTS

SUPPORTING DEVICES

- 2.1 General: Materials procured and installed in this Section shall be in accordance with FAA-C-1217f, FAA STD-019e, and FAA STD-020b.
- 2.2 Coatings: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized.
- 2.3 Manufactured Supporting Devices
- A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps comply with NEC, latest edition and the following requirements:
 - 1. Conform to manufacturer's recommendation for selection of supports.
 - 2. Strength of each support shall be adequate to carry the design load plus 25 percent for future use, multiplied by a safety factor of at least of four. Where this determination results in a safety of less than 200 lbs., provide additional strength until there is a minimum of 200 lbs safety allowance in the strength of each support.
 - B. Fasteners: Types, materials, and construction features as follows:
 - 1. Expansion Anchors: 1/2 inch lead expansion anchors approximately 38 pounds per 100 units.
 - 2. Toggle Bolts: 3/16 inch by 4 inch spring head toggle bolts approximately 5 pound per 100 units.
 - 3. Powder-Driven Threaded Studs: Heat-treated steel, designed specifically for the intended service.
 - C. Channel Systems (U-Channel): Conform with A1011 SS GR 33. 16-gauge channels, stainless steel type 304 for outdoor locations, with 9/16-inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacturer.
 - D. Conduit Sealing Bushings: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in conduits subject to exposure to water and/or oil penetration at conduit joints. Provide plugs with number and size of conductor gripping holes as required to suit installation. Construct body of malleable iron casting with hot-dipped galvanized finish.
 - E. Conduit Sleeves and Seals: Provide conduit sleeves and seals of types, sizes and materials indicated with the following features:
 - 1. Provide factory-assembled watertight wall and floor seals of types and sizes suitable for sealing conduit, pipe, or tubing passing through concrete floors and walls. Construct with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps and cap screws.

- F. Continuous Slotted Channels: Dimensions as required for loads imposed.
- G. Clamps: Sized for application.

2.4 Fabricated Supporting Devices

- A. General: Shop or field-fabricated supports or manufactured supports assembled from U-channel components.
- B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.
- C. Pipe Sleeves: Provide pipe sleeves for steel pipe to be fabricated from Schedule 40 galvanized steel pipe.
- D. Supporting devices shall meet seismic requirements of Zone B.
- E. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified Professional Engineer, using performance requirements indicated in application.

PART 3 – EXECUTION

3.1 Installation

- A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.
- B. Coordinate with the building structural system and with other electrical installation.
- C. Raceway Supports: Comply with the NEC and the following requirements:
 - 1. Conform to manufacturer's recommendations for installation of supports.
 - 2. Space supports for raceways in accordance with the NEC.
 - 3. Support exposed and concealed raceway within 3 feet of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.
 - 4. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.
- D. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.
- E. Cable Supports:
 - 5. Install in strict compliance with manufacturer's instructions.
 - 6. Spacing not to exceed NFPA 70, latest edition, tabulation for spacing of conductor supports.
 - 7. Allow adequate slack in conductors to prevent any stress on terminations. Take into consideration conductor thermal contraction.

8. Train cables for a neat and orderly installation.
- F. Sleeves: Install in concrete slabs and walls for raceways and cable installations. Tighten sleeve seal nuts until sealing grommets have expanded to form a watertight seal.
- G. Fastening: Unless otherwise indicated, fasten electrical items (including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, lighting fixtures and control components) and their supporting hardware securely to the building structure in accordance with the following:
1. Toggle bolts on hollow masonry units;
 2. Concrete inserts or expansion bolts on concrete or solid masonry;
 3. Machine screws, welded threaded studs, or spring-tension clamps on steel.
 4. Sheet metal screws in partitions of light steel construction.
 5. Threaded studs, driven by a powder charge and provided with lock washers and nuts, may be used instead of expansion bolts and machine or wood screws.
 6. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures.
 7. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
 8. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load.
Use vibration and shock-resistant fasteners for attachments to concrete slabs.
- H. Loads applied to any fastener shall not exceed one-fifth of the proof test load.
- I. Tests:
1. Test pull-out resistance of one of each type, size, and anchorage material for the following fastener types:
 - a. Expansion anchors.
 - b. Toggle bolts.
 - c. Powder-driven threaded studs.

END OF SECTION

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 Summary

- A. This Section includes identification of electrical materials, equipment, and associated installation.

It includes requirements for electrical component identification, including but not limited to the following:

1. Buried electrical line warnings
2. Identification labeling for raceways, cables, and conductors
3. Equipment labels and signs
4. Panel Schedules

1.2 Reference Standards

Applicable only to the extent specified.

- A. American Standards Institute (ANSI)
1. A13.1 Scheme for the Identification of Piping Systems
- B. Federal Aviation Administration (FAA)
1. C-1217f Electrical Work, interior
- C. National Fire Protection Association (NFPA), latest edition
1. 70 National Electrical Code (NEC), latest edition

1.3 Submittals

- A. Product Data: Product Data for each type of product specified.
- B. Schedule: Schedule of identification nomenclature, abbreviations and equipment designations to be used for identification signs.
- C. Samples: Samples for each color, lettering style, and other graphic representation required for identification materials; samples of labels and signs.
- D. Text: Size and lettering text on each nameplate.

1.4 Quality Control

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70 latest edition.
1. ANSI Compliance: Comply with requirements of ANSI standard A13.1, "Scheme for Identification of Piping Systems", with regard to type and size of lettering for raceway and cable labels.
 2. National Fire Protection Association (NFPA): Comply with NFPA 70, latest edition, requirements for Identification and for provision of warning and caution

signs for wiring and equipment.

- 1.5 Sequencing and Scheduling: Coordinate installing electrical identification after completion of finishing where identification is applied to field-finished surfaces.

PART 2 - PRODUCTS

2.1 General

- A. Materials, identification, and procedures shall be in accordance with FAA C-1217f.
- B. Except as otherwise noted provide manufacturer's standard products of categories and types required for each application.
- C. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations used in the Contract Documents or required by codes and standards. Provide numbers, lettering and wording as approved in submittals as required by code or as recommended by the manufacturer.

2.2 Raceway and Cable Labels

- A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Contractor's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. ANSI Compliance: Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.
 - a. Color: White legend on a black field.
 - b. Legend: Indicates voltage and source/service (and termination point for control cables).
- C. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl. Legend is laminated with a clear, weather- and chemical-resistant coating.
- D. Engraved Plastic-Laminated Nameplates: Provide nameplates for all new equipment to match existing nameplates at site.
- E. Pre-tensioned, Wrap-around Plastic Sleeves: Flexible, preprinted, color-coded, acrylic bands sized to suit the diameter of the line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position.
- F. Tape Labels: Embossed adhesive tape with 1/4 inch (minimum) white letters on a black background.
- G. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- H. Underground Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:

1. Size: Not less than 6 inches wide by 4 mils thick.
 2. Compounded for permanent direct-burial service.
 3. Embedded continuous metallic strip or core.
 4. Printed Legend: Indicates type of underground line.
- I. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters for Designation purposes.
- J. Aluminum, Wraparound Marker Bands: Wrap-around bands cut from 0.014-inch-thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
1. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, except as otherwise indicated, with eyelet for fastener.
- K. Copper, Brass or Aluminum Tags: Metal tags with stamped legend, punched for fastener.
Dimensions: Tags shall be circular in shape, two inches minimum diameter, by 0.02 inch thick for copper or by 0.05 inch thick for brass or aluminum.

2.3 Engraved Name Plates and Signs

- A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Engraving stock: Melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 sq. in. or 8 inches in length; 1/8 inch thick for larger sizes. Minimum width of engraving stock shall be 2 times letter height.
- C. Engraved legend: Engraved three layer laminated plastic white letters on black background.
- D. Letter Height: Lettering for equipment identification shall be 3/8 inch high. Voltage rating and source lettering shall be 1/4 inch high.
- E. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched for mechanical fasteners, with colors, legend, and size as indicated or as otherwise required for the application. Use 1/4-inch grommets in corners for mounting.
- F. Wire and Cable Markers: Cloth markers, split sleeve or tube type.
- G. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, non-fading, preprinted, cellulose acetate butyrate signs with 0.0396-inch, galvanized steel backing, with colors, legend, and size appropriate to the application. Use 1/4-inch grommets in corners for mounting. Signs shall be punched for mechanical fasteners.
- H. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.
- I. Tape Labels: Embossed adhesive tape with 1/4 inch (minimum) white letters on a

black background.

2.4 Miscellaneous Identification Products

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties with the following features:
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength: 50 lb minimum.
 - 3. Temperature Range: Minus 40 to 185 deg F.
- B. Paint: Alkyd-urethane enamel over primer as recommended by enamel manufacturer.

PART 3 - EXECUTION

3.1 Installation:

- A. Existing Nameplates: Install nameplates for all new equipment to match existing nameplates on site.
- B. Consistency: Use consistent designations throughout the Project
- C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.
 - 1. Self-Adhesive Identification Products: Degrease and clean surfaces of dust, loose material, and oily films before applying.
- D. Raceway/Cable Identification of Special Systems: Identify raceways and exposed cables of special systems with color banding and black lettering appropriately sized for conduit. Band exposed and accessible raceways of the systems listed below for identification.
 - 1. Bands: Pre-tensioned, snap-around, colored plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit place adjacent bands of 2-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25 feet in congested areas.
- E. Circuit Identification Labels on Boxes: Label externally as follows:
 - 1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label, as well as “magic marker” on cover.
 - 2. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
- F. Underground Utility Line Warning Tape: During trench backfilling, for exterior underground power, control, signal, and communications lines, install continuous underground plastic line marker with metallic tracer located directly above line at 6 inches below finished grade. Where multiple lines installed in a common trench or concrete envelope do not exceed an overall width of 16 inches, use a single line marker.
 - 1. Install line marker for underground wiring, both direct buried and in raceway.
- G. Color Code Conductors: The following field-applied color-coding methods may be used

in lieu of factory-coded wire listed in part 2 of Section 16120, "Wires and Cables," for sizes larger than No. 4 AWG. Contractor shall demonstrate non-availability of factory colored wire before using this application

1. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last 2 turns of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings.
 - a. Where conductors are color coded by this method, they shall be color coded in accessible raceways, panelboards, outlets, and switches, as well as at all terminations. Conductors in accessible raceways shall be color coded so that by removing or opening any cover, the coding will be visible.
 2. Green insulated conductors shall not be re-identified for purposes other than grounding.
 3. White or neutral gray conductors shall not be re-identified for purposes other than grounded neutrals.
- H. Power Cable Identification: Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in pull boxes, junction boxes, handholes, switchgear rooms, switchboard rooms, engine generator rooms, UPS rooms, and all electrical closets.
1. Legend: 1/4-inch letter and number, stamping or embossing, with legend corresponding to indicated circuit designations.
 2. Fasten tags with cable ties; fasten bands using integral ears.
- I. Conductor Identification for Other Systems:
1. Install cable tags in each handhole with not less than two tags per cable, one near each duct entrance hole.
 - a. Attach tags to cable immediately after installation.
 - b. Cable terminations shall be tagged as to function.
 - c. Attach securely to cable using 1/8 inch nylon cord.
- J. Signage: Install warning, caution, and instruction signs as follows:
1. Install signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved, plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing in outdoor locations.
- K. Identification Labels: Install identification labels as follows:
1. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. The first line shall show the equipment ID, the second line shall show the voltage and source.
 2. Apply labels for each unit of the following categories of equipment:
 - a. Electrical cabinets, and enclosures
 - b. Access doors and panels for concealed electrical items
 - c. Disconnect switches
 - d. Enclosed circuit breakers
 3. Apply identification labels of engraved plastic laminate for disconnect switches,

enclosed breakers, and similar items for power distribution and control components above, except panelboards where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

4. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
5. Tag cables in each handhole with not less than two tags per cable, one near each duct entrance hole.
 - a. Attach tags to cable immediately after installation.
 - b. Attach securely to cable using 1/8 inch nylon cord.
6. Complete Attachment "A" Panel Schedule for "As Builts", changes and/or revisions.

END OF SECTION

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SECTION 16410
DISCONNECT SWITCHES AND CIRCUIT BREAKERS

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SECTION 16470
PANELBOARDS AND OVERCURRENT PROTECTIVE DEVICES

Not Used

DRAFT

SECTION 16491
FUSES

Not Used

DRAFT

SECTION 16510
LIGHTING FIXTURES
Not Used

DRAFT

SECTION 16521
EXTERIOR LIGHTING
Not Used

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SECTION 16632
PROPANE ENGINE GENERATOR INSTALLATION

Not Used

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